COMPARATIVE STUDY OF HAEMATOLOGICAL INDICES IN CORD BLOOD VS PERIPHERAL VENOUS BLOOD IN PREDICTING EARLY ONSET NEONATAL SEPSIS

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BONAFIDE CERTIFICATE

Certified that this dissertation entitled "**COMPARATIVE STUDY OF HAEMATOLOGICAL INDICES IN CORD BLOOD VS PERIPHERAL VENOUS BLOOD IN PREDICTING EARLY ONSET NEONATAL SEPSIS"** is a bonafide work done by **DR.MAHALAKSHMI.P** postgraduate student of paediatric medicine , Government Kilpauk Medical college & Hospital, during academic year 2015-2018.

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Certified that this dissertation entitled "**COMPARATIVE STUDY OF HAEMATOLOGICAL INDICES IN CORD BLOOD VS PERIPHERAL VENOUS BLOOD IN PREDICTING EARLY ONSET NEONATAL SEPSIS"** is a bonafide work done by **DR.MAHALAKSHMI.P,** postgraduate student of paediatric medicine , Government Kilpauk Medical college & Hospital, during academic year 2015-2018, Under the guidance of **Prof.Dr.K.DEVI MEENAKSHI M.D.,D.C.H.**

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DECLARATION

I declare that this dissertation entitled "**COMPARATIVE STUDY OF HAEMATOLOGICAL INDICES IN CORD BLOOD VS PERIPHERAL VENOUS BLOOD IN PREDICTING EARLY ONSET NEONATAL SEPSIS**" has been conducted by me at Government Kilpauk Medical College and Hospital. It is submitted in the fulfillment of the award of the degree of M.D (Paediatrics) for the May 2018 examination to be held under **the Tamilnadu DR.M.G.R Medical University, Chennai.** This has not been submitted by me for the award of any degree or diploma from any other university.

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TABLE OF CONTENTS

- ABBREVIATION
- MASTER CHART

INTRODUCTION

Neonatal sepsis is a common and major risk factor for neonatal morbidity and mortality in the developing countries (1).

As per National Neonatal Perinatal Database (NNPD) 2002-2003, the incidence of neonatal sepsis in India was 30 per 1000 live birth (2).

The incidence of EOS was 8-10 per 1000 live births and it constituted 55.4% of overall sepsis (1).

Neonatal Sepsis can be divided into two groups named as early onset (first 72 hours of life) and late onset sepsis (>72 hours) (3).The case fatality rate is higher in early onset sepsis as compared to late onset sepsis. The neonates have prematurity of immune system, hence it is agreed that neonatal sepsis is a syndrome, expressing both metabolic and haemodynamic impairments, brought about by infection. The clinical manifestation of sepsis in newborn infants is

usually non-specific; thereby diagnosis of sepsis only by clinical findings is difficult (4). Thus, diagnosis of sepsis relies on combination of various laboratory tests.

The usual practice is, after development of clinical sepsis i.e. significant multisystem disease; blood sample is collected by venipuncture from the neonates and sent for culture and haematology. Collection of blood sample can induce pain to the neonates. If this process were used, babies would not need to have blood drawn and would experience less pain and antibiotics can be started earlier to avoid neonatal morbidity. . Shortly after delivery, well infants at risk for sepsis are removed from their family, thus interrupting the bonding process. This is distressing to the family, knowing that their newborn infant is about to have a painful procedure out of their presence and comfort. Often an infant will be admitted into a triage bed for evaluation. If the venipuncture is unsuccessful, it may need to be repeated multiple times (5). Often it is difficult to obtain an adequate volume of blood from a newborn which may cause a delay in bacterial growth or may be difficult to interpret (6). The volume of blood obtainable from the umbilical cord is usually more than adequate.

The use of umbilical cord blood would allow the entire evaluation to be performed in the labor or delivery room. The specimen would be attained at the

earliest possible time, allowing rapid institution of antibiotic therapy. The method is noninvasive and nontraumatic and may be performed by a less skilled member of the health care team, and an adequate volume of blood could be easily obtained (6).

AIM OF THE STUDY

- To study the haematological indices in cord blood of infants at risk of early onset sepsis.
- To predict early onset neonatal sepsis

NEONATAL SEPSIS

DEFINITION

Neonatal sepsis is a clinical syndrome of bacteremia characterized by systemic signs and symptoms of infection and documented by a positive blood culture in the first four weeks of life. Older textbooks may refer neonatal sepsis as "sepsis neonatorum".

CLINICAL SEPSIS is defined as neonates presenting with clinical symptoms and signs of sepsis without laboratory findings consistent with sepsis.

PROBABLE SEPSIS : clinical and laboratory findings are consistent with sepsis but blood culture is negative.

PROVEN SEPSIS : neonate with clinical picture suggestive of sepsis and positive culture (blood/urine/CSF).

INCIDENCE

Incidence of neonatal septicemia differs among hospitals, depending on the factors such as obstetric and nursery practices, prenatal care, the health and nutrition of the mother and the incidence of prematurity.

As per National Neonatal Perinatal Database (NNPD) 2002-2003, the incidence of neonatal sepsis in India was 30 per 1000 live birth (2).

The incidence of EOS was 8-10 per 1000 live births and it constituted 55.4% of overall sepsis (1).

Neonatal sepsis was one of the common causes of neonatal mortality contributing to 23% of all neonatal deaths.

Klebsiella and staphylococcus aureus were the two most common organisms isolated in the developing countries like india. Developed countries did have gram negative organism as predominant pathogen decades ago . In India ,it is quite possible that with passage of time,gram negative organisms may be replaced by Group B streptococcus.indication of the same has come from few centres ,including CMC Vellore of South India,reporting an increasing incidence of Group B streptococcus.(7).

CLASSIFICATION OF NEONATAL SEPSIS

Neonatal sepsis can be divided into two types depending upon whether the onset of symptoms is within the first 72 hours of life or later.

EARLY ONSET SEPSIS

Although the term early onset neonatal sepsis had been used to refer to infections occurring as late as one week of age, it should be restricted to those infections with a perinatal pathogenesis, the usual onset of which occur within 72 hours. Early - onset sepsis is caused by organisms prevalent in genital tract or in the labour room. Ascending infection and transplacental hematogenous spreads are important mechanisms implicated in the acquisition of infection by the neonate. The organisms enter the body through the umbilicus, skin or mucosa.

Due to poor immunity of the new born, even local infections tend to become generalised. Early onset sepsis can manifest as a fulminant disease with immediate onset of respiratory distress soon after delivery or on day one to three of postnatal life after an asymptomatic period. Infections are more commonly seen in preterm and low birth weight babies.

LATE ONSET SEPSIS (LOS)

It usually presents after 72 hours of age. The source of infection in LOS is either nosocomial (hospital-acquired) or community-acquired and neonates usually present with septicemia, pneumonia or meningitis (8,9).

Various factors that predispose to an increased risk of late onset sepsis include

- Low birth weight,
- Preterm labour,
- Admission in intensive care unit
- Mechanical ventilation,
- Invasive procedures
- Administration of parenteral fluids.

Factors that may increase risk of community-acquired late onset sepsis include poor hygienic practice by the caretaker, poor cord care, use of bottle-feeding and prelacteal feeds. Breast-feeding, on the other hand, prevents infection in neonates.

Risk factors for early onset neonatal sepsis: (10,11)

1. Low birth weight (<2500 grams) or preterm baby
2. Febrile illness in the mother within 2 weeks prior to delivery.
3. Foul smelling and/ or meconium stained liquor amnii.
4. Prolonged rupture of membranes >24 hours.
5. More than 3 vaginal examinations during labor
6. Prolonged and difficult delivery with instrumentation

7. Perinatal asphyxia (Apgar score <4 at 1 minute or age) or difficult resuscitation

8. Pathological evidence of funisitis or presence of polymorphs (> 5 / HPE) in the gastric aspirate.

Neonates with presence of foul smelling liquor or three of the above mentioned risk factors should be considered to have early onset sepsis and treated with antibiotics.

Presence of ≥ 2 risk factors should be investigated with a septic screen and treatment should be initiated accordingly.

Clinical features

Non-specific features

The earliest signs of sepsis are often subtle and nonspecific; thus, a high index of suspicion is needed for early diagnosis and preventing complications. Neonates with sepsis may present with one or more of the following symptoms and signs.

Hypothermia or fever – hypothermia is more common in low birth weight and preterm babies.

- Lethargy, poor cry, refusal to suck

- Poor perfusion, prolonged capillary refill time
- Hypotonia, absent neonatal reflexes
- Brady/tachycardia
- Respiratory distress, apnea and gasping respiration
- Hypoglycemia, hyperglycemia, Metabolic acidosis.

Specific features related to various systems

Central nervous system (CNS): Bulging anterior fontanelle, blank look, high-pitched cry, lethargy, excess irritability, comatose, seizures, neck retraction. Presence of these features should raise a clinical suspicion of meningitis .

Cardiovascular system tachycardia, Hypotension, poor perfusion with capillary filling time > 3 seconds, cyanosis,shock

Gastrointestinal: poor feeding, Feed intolerance, excessive prefeed residue, vomiting, diarrhea, abdominal distension, paralytic ileus, necrotizing enterocolitis (NEC).

Hepatic: Hepatomegaly, direct hyperbilirubinemia (especially with UTI)

Renal: oliguria,Acute renal failure

Hematological: Bleeding manifestation, petechiae, purpura

Skin changes: Multiple pustules, abscess, sclerema, mottling, umbilical redness and discharge.

Swollen/tender joints/bones.

INVESTIGATIONS

It is important that the supportive and antimicrobial therapy of a neonate with sepsis should be instituted quickly.Hence minimum and rapid investigations should be done as early as possible.

Direct methods of screening include the following

Examination of gastric aspirates for polymorphonuclear cells had been used as a screening procedure for noenatal sepsis. Aspiration to be done within 1 hour of birth before starting the feeds.

- It is not useful if it is contaminated with blood or meconium.
- Aspirate should be stained with Leishman stain.
- 5 polymorphs / HPF is taken as abnormal.
- Microscopy of buffy coat smear stained with methylene blue.

Indirect markers to diagnosis sepsis:

Among them commonly and widely used indirect markers of infection are

1. Total leucocyte count

2. Absolute neutrophil count
3. (Band forms) Immature to total neutrophil ratio > 0.2
4. C-reactive protein (CRP)
5. Micro ESR

When these are studied collectively, called ‘Sepsis Screen “

SEPSIS SCREEN ABNORMAL VALUES

COMPONENTS	ABNORMAL VALUES
Total leucocyte count	< 5000/ cu mm
ANC	As per Manroe and Mouzinho chart
Micro ESR	>15 mm in 1^{st} hr
Platelet count	< 150000/ cu mm
I/T RATIO	>0.2

Total leucocyte count

Normal count ranges from 9000 to 30,000 cells/mm^2 at the time of birth and the differences in the site of sampling and activity of the baby can affect the value.

M.Xanthou in 1970 studied leucocyte blood picture in healthy full term and premature babies during neonatal period. Serial leukocyte counts were done on 15

full term during first 10 days of life and on 14 preterms during first 30 days of life. The main changes in the leucocyte count during the neonatal period were as follows – an increase in polymorphonuclear neutrophils after birth reaching a peak at 12 hours, thereafter dropping to a figure which remains fairly constant from 72 hours onwards[12].

The micro-Erythrocyte sedimentation rate

Micro ESR is performed by measuring in millimeters ,the settling of erythrocytes in a vertically placed capillary tube in 1 hr.

Normal value increases with post natal age and are equal to the day of life plus 3mm/hr, upto a maximum of 15mm/hr.

The micro Erythrocyte sedimentation rate is a nonspecific indicator of tissue damage and is known to be elevated in infective states. The rate of increase depends on the severity of the morbid process.

False positive reactions can occur with hemolysis and even in physiological jaundice, whereas false negative results may be due to disseminated intravascular coagulation with consumption of fibrinogen which affects roleaux formation(13).

Anita Sharma et al (14) in their study of 65 clinically suspected cases of neonatal septicemia reported the elevated C-reactive protein and elevated micro – ESR compared to controls at the time of diagnosis, but micro – ESR had no prognostic significance and C-reactive protein levels decreased with treatment.

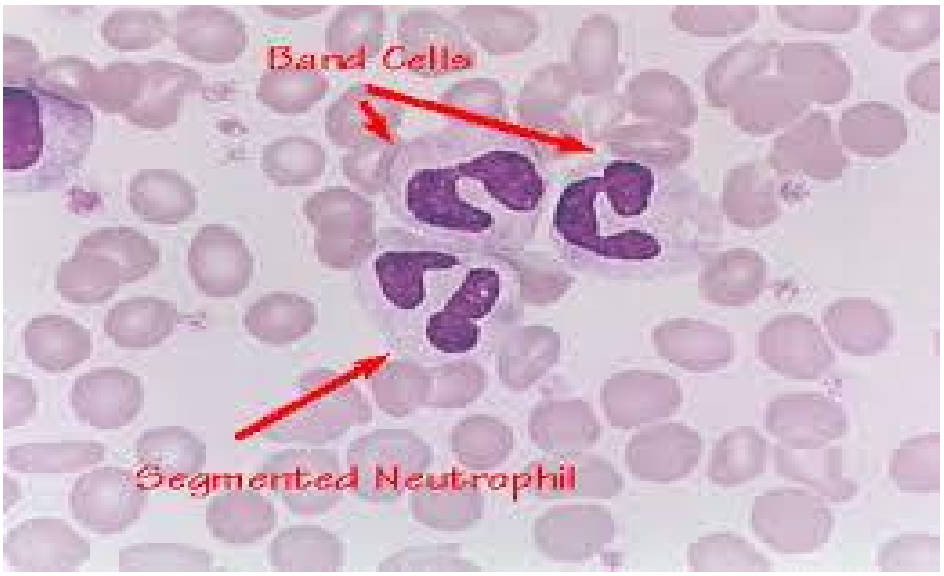
Absolute neutrophil count and Immature to total neutrophil ratio

- Knowing the total leukocyte count and differential count, absolute neutrophil count can be calculated.
- Then the absolute neutrophil count and was noted in monroe's chart. Absolute neutrophil count outside the normal as seen in munroe's chart was taken as positive

Neutrophil indices like absolute neutrophil count and the ratio of band form to total neutrophil count(I/T ratio)has proven more useful than other indices.

The lower level of neutrophil count is 1700cells/mm^2 at birth raises to 7200cells/mm^2 by 12 hrs of life. It declines to 1720/mm^2 by 72 hrs of life. (15).

Immature neutrophil or band form is a neutrophil in which the width of the narrowest segment of the nucleus is not less than one third of the broadest segment. Immature neutrophils (Band cells + myelocytes + metamyelocytes) to total neutrophils ratio (l/T) > 0.20 means that immature neutrophils are over 20 percent of the total neutrophils because bone marrow pushes even the premature cells into circulation, to fight infection.



The absolute band form count also undergoes similar changes postnatally. It attains peak value of 1400cells/mm3 at 12 hr of life and then declines. I/T ratio is maximum at birth 0.16 and then decline to a value of.12 at 72 hrs of life.

The reference ranges of each of these indices were established by Monroe et al (15)in 1979.

Mouzinho A et al (16) observed that very low birth weight babies i.e <1500gm (<30 week) often had neurtophil indices that did not fall within the range of Manroe's (17).his reference range is shown in the table below.

TABLE I

Mouzinho A et al[46] Revised reference ranges for circulating neutrophils	Absolute neutrophil count	
	Minimum	**Maximum**
Birth	500	6000
18hrs	2200	14000
60hrs	1100	8800
120hrs	1100	5600

Monroe et al (15) in 1979 observed that mild or early-onset of infection caused a significant increase in absolute value of neutrophils. The values were as, high as 17,500/cmm.

Monroe et al. (15) also observed a 100% negative predictive value if the total neutrophil count, immature neutrophil count, and I/T were all normal.

PLATELET COUNT

Thrombocytopenia is classified as

Mild	-	100000 to 150000 / cu mm
Moderate	-	50000 to 99000 / cu mm
Severe	-	< 50000 / cu mm

Mean platelet count are lower in preterm neonate than term or near term neonates.(18).

Incidence of thrombocytopenia is inversely correlated to the gestational age, reaching approximately 70 % among neonates born with a weight < 1000 gram (19).

Blood culture

It is the gold standard for the diagnosis of sepsis and should be done in all cases of suspected sepsis prior to starting antibiotics. A positive blood culture and sensitivity of the isolate is the best guide to antimicrobial therapy. Therefore blood culture should be strictly taken under aseptic precautions to avoid contamination.

The person involved should wear sterile gloves for the procedure and should prepare a patch of skin approximately 5-cm in diameter over the proposed

veni-puncture site.This area should be cleaned thoroughly with alcohol followed by povidone-iodine, followed by alcohol again. Application of povidone-iodine should be done in concentric circles moving outward from the centre. The skin should be allowed to dry for a minimum of 1minute before the sample is collected.

A one-ml sample of blood should be withdrawn for a blood culture bottle containing 5-10 ml of culture media. Blood cultures should be collected from a fresh veni-puncture site because samples collected from indwelling lines and catheters are likely to be contaminated.

It is now possible to obtain bacterial growth within 12-24 hours by using improved techniques such as BACTEC and BACT/ALERT blood culture systems. These techniques are having the advantage of detecting the bacteria at a concentration of 1-2 colony-forming unit (cfu) per ml.

Mathur et al. in 1991(20)found that the Klebsiella (38.6%), Staphylococcus aureus (21.5%) were the most commonly isolated pathogens with higher mortality ininfections with Gram-negative (63.5%) than with Gram-positive organisms (19.1%). Blood cultures should be observed for a period of atleast 72 hours before they are reported as sterile.

Piyush Gupta et al. in 1993(21) in their study concluded that Klebsiella septicemia continues to be on priority list of nosocomial neonatal infections as

evidenced by the rising incidence. Klebsiella septicemia affects the most vulnerable, has more incidences of complications and carries high mortality rate.

Moreno et al. in 1994 (22) in their study of 577 cases with culture proved sepsis found that Gram-negative bacilli particularly species of Klebsiella and E-coli were responsible for 61% of infections, whereas Gram-positive isolates especially Staphylococci and Candida were responsible for 37% and 2% respectively. Case fatality rate was 32%.

Mortality was greater in infants with early-onset sepsis than in those with late onset sepsis.

Endo et al. in 1996 found that Klebesiella pnuemonae and E-coli have been replaced by Staphylococcus aureus and Pseudomonas aeruginosa as the predominant isolate in newborn with sepsis (18).

Among the intramural live births, Klebsiella pneumoniae was the most frequently isolated pathogen (31.2%) followed by Staphylococcus aureus (17.5%).

Among extramural babies, Klebsiella pneumoniae was the commonest organism (36.4%), followed by Staphylococcus aureus (14.3%) and Pseudomonas (13.2%).

Lumbar puncture (LP)

Since clinical features of meningitis are non-specific in neonates, it is likely that it may be present without specific symptomatology along with sepsis.

Kaftan H et al 1998 (23) in their study, the incidence of meningitis in neonatal sepsis has from 0.3-3% and 0.5% according to the NNPD 2002-2003 data.

However the morbidity involved with a delayed or a missed diagnosis of meningitis probably due to the extra precaution involved in performing lumbar punctures in neonates suspected of septicemia.

In early onset sepsis, a lumbar puncture is indicated in the presence of either a positive blood culture or presence of clinical picture of septicemia. It is probably not indicated if antibiotics have been started solely due to the presence of risk factors only.

In late onset sepsis, a lumbar puncture is indicated in all infants with signs and symptoms prior to starting antibiotics. The lumbar puncture should be postponed in a critically sick and hemodynamically unstable baby.

Table - 2

CSF COMPONENTS	NORMAL RANGE
Cells /cu mm	8 (0 – 30)
PMN %	60 %
Proteins mg/dl	90 (20 – 170)
Glucose mg/dl	52 (34 - 119)
Protein/glucose %	5 (44 - 248)

Radiology

- Chest x-ray in the presence of respiratory distress/ apnoea
- Abdominal x-ray is indicated if abdominal signs are present and/ or suspicion of necrotizing enterocolitis (NEC).
- Ultrasound head and CT scan in neonates diagnosed to have meningitis.

Urine culture

Francisco J. Garcia et al, in 2002 done a study and found the incidence of UTI between 5% and 11%.(24).

In early onset sepsis, urine cultures have a low yield and are not Indicated. Suprapubic bladder puncture sample or bladder catheterization sample has been recommended in all cases of late onset sepsis, the procedure is painful and the yield is very poor.

However, neonates at risk for fungal sepsis and very low birth weight babies with poor weight gain should have a urine examination to exclude urinary infection.

Urinary tract infection may be diagnosed in presence of one of the following:

(a) >10 WBC/mm^3 in a 10 ml centrifuged sample

(b) $>10^4$ organisms /ml in urine obtained by catheterization

(c) Any organism in urine obtained by suprapubic aspiration

DIC : prothrombin time,aPTT, fibrin degration products, D – dimers.

Newer investigations

- Procalcitonin assay.

  It can distinguish infection and inflammation and differentiate between bacterial and viral infections with high specificity.

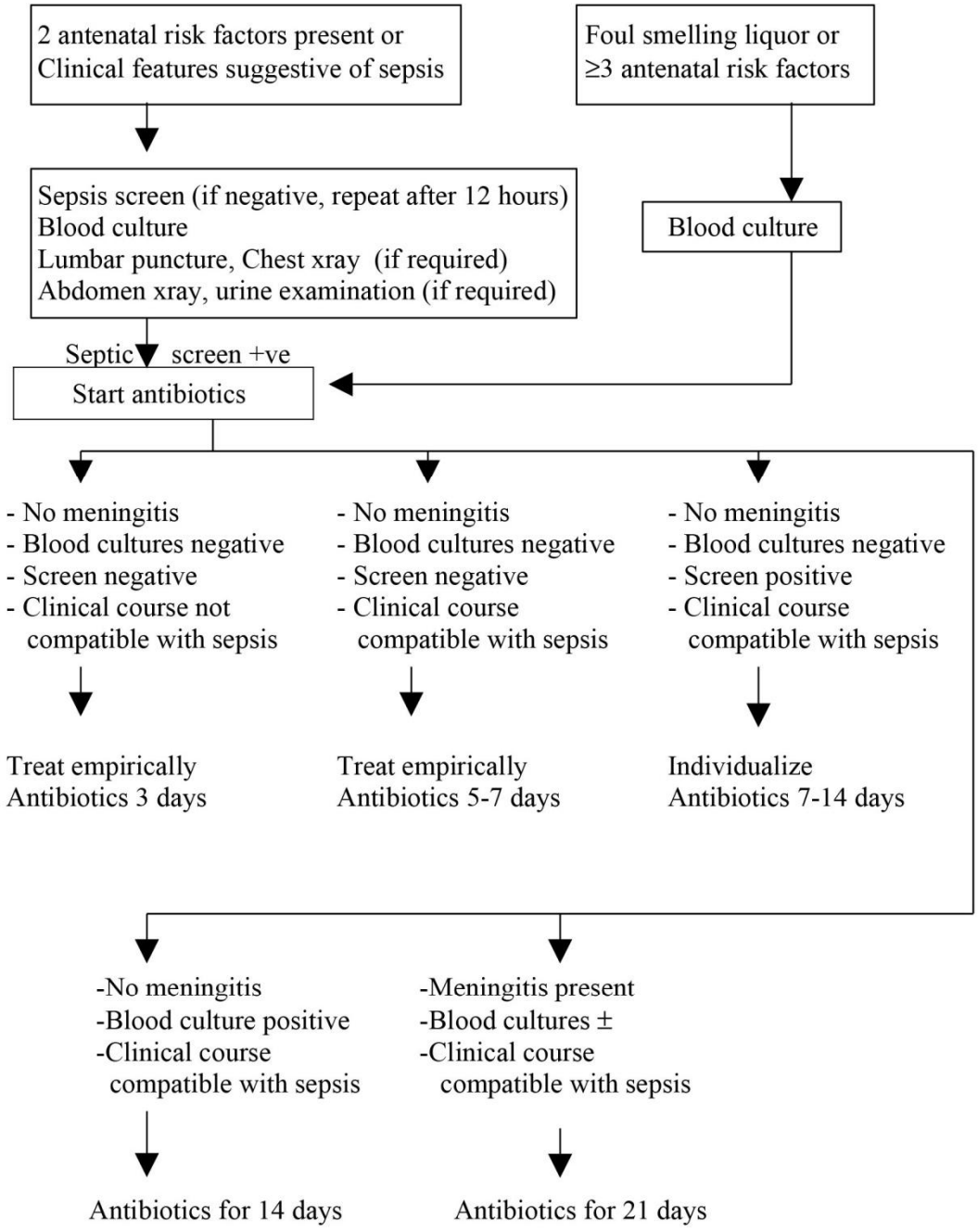
- Fibronectin
- Alpha 1 antitrypsin
- Alpha 1 chymotrypsin
- Haptoglobulin.
- Fibrinogen
- IL-1
- IL-6 IL-8
- TNF-α
- G-CSF
- Leucocyte α 3 proteanase inhibitor

- CD116
- CD64
- PCR for genetic DNA of microbes

These markers have not yet made progress from laboratory to clinical application(25).

MANAGEMENT

Protocol for sepsis



NB. If no response is seen within 48-72 hours of starting treatment, a repeat blood culture should be obtained to determine appropriate choice and duration of antibiotic therapy. A lumbar puncture should be repeated in gram negative meningitis to assess for response to therapy.

SUPPORTIVE THERAPY

- Maintain airway and supplement with oxygen
- Blood pressure and perfusion should be monitored frequently .
- Maintenance of euthermia
- Maintenance of euglycemia
- Feeding is withheld in suspected NEC
- Mechanical ventilation in case of recurrent apnoea and respiratory failure.

Antimicrobial therapy

There cannot be single recommendations for the antibiotic regimen for neonatal sepsis in all settings.

The choice of antibiotics depends on the flora responsible for sepsis in the given unit and their sensitivity to antibiotics.

Decision to start antibiotics is based upon clinical features and/ or a positive septic screen. But the duration of antibiotic therapy depends upon the presence of a positive blood culture and meningitis.

Duration of antibiotic therapy

Diagnosis	Duration
Meningitis	21 days
Blood culture positive	14 days
Culture negative but definite clinical sepsis	10 – 14 days
Culture negative,clinically probable sepsis, sepsis screen positive	7 – 10 days
Culture negative,clinically probable sepsis, screen negative	5 – 7 days

Criteria to start antibiotics in neonates at risk of early onset sepsis include the following

(a) presence of three risk factors for early onset sepsis

(b) presence of foul smelling liquor

(c) presence of ≥2 antenatal riskfactor(s) with a positive septic screen and

(d) strong clinical suspicion of sepsis.

The indications to start antibiotics in late onset sepsis include

(a) positive septic screen and / or

(b) strong clinical suspicion of sepsis

Indication for prophylactic antibiotics

a) exchange transfusions should be treated with prophylactic antibiotics.

b) neonates on mechanical ventilation.

Choice of antibiotics

Empirical selection of antibiotics should be unit specific and determined by the prevalent organism in that unit and their antibiotic sensitivity pattern. Antibiotics once started should be modified according to the culture sensitivity reports.

The empirical choice of antibiotics is dependent upon the probable source of origin of infection.

For infections that are likely to be community-acquired and where resistant strains are uncommon; a combination of ampicillin or penicillin with gentamicin may be a good choice for first line therapy. Chloramphenicol may be added to treat meningitis acquired from the community.

For infections that are acquired in the hospital , resistant pathogens are likely and a combination of ampicillin or cloxacillin with gentamicin or amikacin may be instituted.

Cefotaxime or Ceftriaxone should be added for treatment of meningitis where resistant strains are likely.

In nurseries where this combination is ineffective due to the presence of resistant strains of klebsiella and other gram-negative bacilli, a combination of a third generation cephalosporin with amikacin is effective.

Reserve antibiotics

Third generation cephalosporins including cefotaxime, ceftriaxone and ceftazidime have good antimicrobial activity against gram negative organisms (including klebsiella) and have very good CSF penetration.

Ceftazidime is particularly effective against pseudomonas infections. These antibiotics are an excellent choice for the treatment of nosocomial infections and meningitis.

Newer antibiotics like aztreonam and imepenem are also now available. Aztreonam has excellent activity against gram-negative organisms. Imepenem is effective against most bacterial pathogens except methicillin resistant Staphylococcus aureus (MRSA) and Enterococcus.

The empirical use of the last two antibiotics is best avoided and should be reserved for situations where the isolate is sensitive to them.

Ciprofloxacillin is another antibiotic with excellent activity against gram-negative organisms although it does not have very good CSF penetration. Hence ciprofloxacin may be used for the treatment of resistant gram-negative bacteremia after excluding meningitis.

A combination of piperacillin or ceftazidime with amikacin should be considered if pseudomonas sepsis is suspected.

Penicillin resistant Staphylococcus aureus should be treated with cloxacillin, nafcillin or methicillin. Addition of an aminoglycoside is useful in therapy against Staphylococcus.

Methicillin resistant Staphylococcus aureus (MRSA) should be treated with a combination of either ciprofloxacillin or vancomycin with amikacin.

For sepsis due to Enterococcus, a combination of ampicillin and gentamicin is a good choice for initial therapy. Vancomycin should be used for the treatment of Enterococcus resistant to the first line of therapy.

Adjunctive therapy

Exchange transfusion (ET)

Sadana et al have evaluated the role of a single double volume exchange transfusion in septic neonates with sclerema and demonstrated a 50% reduction in sepsis related mortality in the treated group(26). double-volume exchange transfusion with cross-matched fresh whole blood as adjunctive therapy in septic neonates with sclerema.

Intravenous Immunoglobulin (IVIG)

Non-specific pooled IVIG has not been found to be useful (27).

Granulocyte-Macrophage colony stimulating factor (GM-CSF)

This mode of treatment is still experimental (28).

COMPLICATION OF NEONATAL SEPSIS

Neurological Complications after Neonatal Bacteremia

Shih-Ming Chu,et al 2014 in their study on Bacteremia-related neurological complications included:(29)

Seizure: neonates without an underlying seizure disorder, brain pathology, or significant metabolic disturbance who had a repeated seizure attack or an abnormal epileptiform discharges on the electroencephalography after bacteremia that required regular anti convulsants medications.

Post-infectious encephalopathy: Neonates who had consciousness change after stabilization of vital signs that lasted >24 hours after the onset of bacteremia.

Hydrocephalus and/or ventriculomegaly: documented by transcranial ultrasound after the onset of bacteremia, and in neonates without previous brain pathology.

The presence of any newly focal infections, including subdural empyema, arachnoiditis, ventriculitis, and spinal abscess or brain abscess.

Other neurologic complications: included neonates with encephalomalacia or cerebral infarction due to hypotension.

Infectious Complications and Morbidities After Neonatal Bloodstream Infections

Ming-Horng Tsai, et al ,2016 (30) in their study on infectious complication and found that

I. Persistent organ damage included acute renal failure with/without the requirement of hemodialysis,

II. acute respiratory distress syndrome (ARDS),

III. disseminated intravascular coagulopathy (DIC),

IV. short bowel syndrome after surgical treatment of NEC or peritonitis,

V. secondary pulmonary hypertension with/without cor pulmonale, VI. multiorgan failure secondary to septic shock.

PREVENTION OF SEPSIS

Newborn care

- Exclusive breastfeeding
- Keep cord dry
- Hand washing by care givers
- Hygiene of baby
- No unnecessary interventions

Hand washing

Simplest, most effective measure for preventing hospital acquired infections

Two minutes hand washing prior to entering nursery and 15 seconds of hand washing before touching the baby.

Alcohol based hand rub effective but costly.

Control of hospital infections

- Hand washing by all staff
- Isolation of infectious patient
- Use plenty of disposable items
- Avoid overcrowding
- Aseptic work culture

- Infection surveillance

Work culture

- Sterile gowns and linen for babies
- Hand washing by all
- Regular cleaning of unit
- No sharing of baby belongings
- Dispose waste-products in separate bins

Control of hospital outbreak of infections

- Epidemiological investigation
- Increased emphasis on hand washing
- Reinforce all preventive measures
- Review of protocols and Review of antibiotic policy
- Cohorting of infants

Fumigation

Use Potassium permanganate 70 gm with 170 ml of 40% formalin for 1000 cubic feet area for 8-24 hours .

Alternatively Bacillocid spray for 1-2 hours may be equally effective.

REVIEW OF LITERATURE

1) Vamseedhar Annam et al in their study to evaluate the role of Cord blood Haematological Scoring System as an early predictive screening method for detection of early onset neonatal sepsis and also to identify the neonates who are at risk of developing neonatal sepsis using cord blood.

The cord blood was collected and analyzed for various Haematological parameters like Total leucocyte count, Absolute Neutrophil count, Immature to mature Neutrophil ratio, immature to mature ratio, Neutrophil morphology, nucleated erythrocytes, platelet count, micro erythrocyte sedimentation rate. Blood cultures were performed as gold standard for diagnosing neonatal sepsis.

Of 153 newborns for analysis, 59 (38.56%) developed sepsis. The haematological scoring system found that an abnormal immature to total neutrophil ratio, Neutropenia, micro erythrocyte sedimentation rate followed by immature to mature neutrophil ratio were the most sensitive indicators in identifying infants with sepsis. The study also found that higher the score, the greater the certainty of sepsis being present.

The haematological scoring system using cord blood can be considered as an early predictive screening method for detection of early onset neonatal sepsis.

Identifying the risk of developing sepsis early can prevent morbidity and mortality of the neonates.

2).PD Carroll et al in their study with CBC and manual differential was performed on 174 paired umbilical cord blood and admission blood samples from infants <35 weeks gestation. Paired t-test and Pearson's correlation coefficient were the primary statistical tools used for data analysis.

Cord and admission blood white blood cell (WBC) count, hemoglobin and platelet count all significantly ($P<0.0001$) correlated with paired neonatal samples ($R = 0.82, 0.72, 0.76$).

Admission blood WBC count fell within the variation of WBC count values from currently accepted neonatal admission blood sources. Cord blood hemoglobin was not clinically different than admission hemoglobin (1.0 g dl−1). Cord blood platelet counts were not different from admission blood platelet counts (5800 cells per μl, $P = 0.23$).

The immature to total granulocyte ratio was not different between samples ($P = 0.34$).Umbilical cord blood can be used for admission CBC and differential in premature infants .

3). Eric s Shinwell et al in their study to evaluate neonate for suspected early neonatal sepsis routinely includes blood tests such as complete blood count, C-reactive protein (CRP) and culture. In order to obviate the need for venepuncture, we prospectively compared these tests in paired samples from umbilical cord and peripheral venous blood drawn during the first hours after birth in both preterm and term infants.

Paired blood samples were studied from asymptomatic neonates with risk factors for early sepsis. Data were collected on maternal and neonatal factors that may have influenced the correlation between the tests.

Three hundred fifty pairs of samples were studied. Significant correlation between umbilical cord and peripheral venous samples was found for white blood cell (WBC; $r = 0.683$) and platelets (PLT) ($r = 0.54$). Correlation for hemoglobin was lower ($r = 0.36$). No cases of early neonatal sepsis were detected.

However, contamination rates were 12% in umbilical cord blood and 2.5% in peripheral venous blood cultures. WBC rose after birth and the 90th percentile rose from 22 500 in umbilical cord blood to 29 700 in peripheral blood. Screening for sepsis with umbilical cord CBC may be useful provided normal ranges are adjusted accordingly.

4).Hansen A et al in their study to assess the correlation of complete blood count (CBC), I: T ratio and blood culture results between umbilical cord and infant blood. It is a prospective cohort study comparing CBC/differential and blood culture results of paired samples of umbilical cord and infant blood from term newborns.

Sent 113 paired samples of cord and infant venous blood for CBC/differential and blood culture. All 113 umbilical cord and infant blood cultures were negative, yielding a false-positive blood culture rate of zero. For 92% of babies, both the cord and infant blood I: T ratio were <0.2 or both were >or=0.2. Cord and infant WBC, hematocrit and platelet counts were moderately to highly correlate.

It was conclude that cord blood can be safely substituted for infant blood in routine sepsis evaluations of asymptomatic, term infants based on both the low false-positive cord blood culture rate and the significant association between high I: T ratios in cord and infant blood. .

5). Madhava R.bheeram et al in their study to evaluate reliability of umbilical cord blood (UCB) for complete blood count (CBC) and blood cultures compared with the infant's blood from peripheral site for group B streptococcal (GBS) sepsis screening.

A total of 200 neonates, at risk for GBS infection, were studied prospectively. After birth, UCB sample was obtained for CBC and blood cultures from umbilical vein. Peripheral arterial/venous blood was obtained from the neonate.

In 200 neonates, CBC counts were similar for clinical significance except for leukopenia (6% in UCB vs 1.2% in peripheral blood, P= .02). One UCB sample grew GBS and another grew microaerophilic streptococcus, a contaminant. A neonatal sample grew Escherichia coli, a pathogen and another neonatal sample grew Staphylococcus auricularis, a contaminant.

Hence it was concluded that CBC results were similar from UCB and the infant for the purpose of GBS screening. Contamination of UCB sample for culture is uncommon. Hence, UCB may be used for GBS sepsis screen.

6. Dennis T. Costakos et al in their study about painless blood testing to prevent neonatal Sepsis. all women colonized with Group B Streptococcus (GBS) at 35-37 weeks, as well as those laboring before this time and all women with GBS urinary tract infections, should be offered intrapartum antibiotic prophylaxis, usually in the form of high-dose intravenous penicillin or ampicillin, unless delivered by planned cesarean section before the onset of labor in a woman with

intact membranes. In term and preterm babies who are born to treated women, in addition to babies who act ill, the recommendation is to treat the baby with antibiotics. In certain circumstances, such as when the mother receives an intrapartum antibiotic <4 hours prior to delivery, the baby receives antibiotics even if the baby appears well.

This paper proposes a new process for testing for GBS that involves using the umbilical cord. If this process were used, babies would not need to have blood drawn and would experience less pain. in infant born of gestational age ≥35 weeks appears well and the mother receives intrapartum antibiotic >4 hours prior to delivery, the baby receives routine care (no neonatal antibiotics).

In contrast, if the intrapar-tum antibiotic is given to the mother <4 hours prior to delivery, a blood culture and complete blood count (CBC) are done, and an I:T ratio is calculated [bands/(segs+bands+metamyelocytes)]. If the I:T ratio is >0.2, the baby receives antibiotics until the blood culture is negative for 48 hours, even if the baby appears well.

In this study they send 1ml of umbilical cord blood in an aerobic culture bottle and 0.5ml of blood to measure complete blood count (CBC)/differential ,

I:T ratio and CRP. We do not need a complete blood count, CRP and I/T ratio on the baby as the substitution of umbilical cord blood .

They concluded that cord blood can be safely substituted for venous blood since cord blood values have 92 % sensitivity in predicting sepsis.

7). Teresa Baker et al in their study on Evidence Based Practice Literature Review Project about Umbilical Cord Blood as an Alternative for Infant Blood in the Neonatal Sepsis Evaluation.

The purpose of this evidence based inquiry is to evaluate the current, best evidence based literature related to methods for rapid and accurate detection of neonatal bacteremia to comply with the CDC guidelines for prevention of GBS disease. The clinical problem that will guide this review is: In the population of neonates <7 days of age, will the use of umbilical cord blood rather than infant blood be a reliable alternative for obtaining a CBC and blood culture for the detection of early onset neonatal sepsis.

Providing there is a significant correlation of the laboratory results, the use of umbilical cord blood for the detection of neonatal bacteremia may prove to be a satisfactory alternative to infant phlebotomy.

From the review of various literatures it was concluded in this study that umbilical cord blood can be safely substituted for infant blood for the entire sepsis evaluation .

It would not be necessary to remove the infant from the parents' presence, and bonding would not be interrupted. The specimen would be attained at the earliest possible time, allowing rapid institution of antibiotic therapy.

The method is non invasive and non traumatic for the infant and may be performed by a less skilled member of the health care team. An adequate volume of blood could be easily obtained .

With the constant drive to improve efficiency and family centered care, health care providers and parents alike will welcome these minor procedural changes in order to reduce painful procedures, inconveniences and expenses .

NEED OF STUDY

- To find the high risk infants at greater risk of developing neonatal sepsis
- To initiate early treatment and to avoid complication

AIMS AND OBJECTIVES

- To study the hematological indices in cord blood of infants at risk of early onset sepsis.
- To predict early onset neonatal sepsis.

MATERIALS AND METHODS

SOURCE OF DATA

It is a hospital based study done at Neonatal intensive care unit,

Government Kilpauk Medical College, Chennai.

STUDY POPULATION

Neonates at high risk of early onset sepsis•

STUDY TYPE

Prospective Cohort study

SAMPLE SIZE

Sample size is 142 with confidence interval of 95 %

INCLUSION CRITERIA

All newborns at high risk of early onset sepsis

- Prematurity / low birth weight < 2500 gm
- Maternal fever > 100.4 *C
- Foul smelling liquor
- PROM > 18 hour

- Prolonged labour (sum of 1st and 2nd stage of labour > 24 hours)
- Single unclean or >3 clean vaginal examination during labour

EXCLUSION CRITERIA

- Neonates with perinatal hypoxia
- Extramural babies

SAMPLE SIZE CALCULATION

Sample size was determined based on

Authored by Vamseedhar Annam et al Published in J Clin Diagn Res. 2015 Sep; 9(9): SC04–SC06.

Evaluation of Cord Blood - Haematological Scoring System as an Early Predictive Screening Method for the Detection of Early Onset Neonatal Sepsis

In this study, of the total 153 full term normal delivery newborns, 59 (38.56%) developed early onset sepsis which were confirmed by positive cord blood culture.

The confidence level is estimated at 95%

with a z value of 1.96

the confidence interval or margin of error is estimated at +/-8

Assuming p% =38.56 and q%=61.44

$n = p\% \times q\% \times [z/e\%]^2$

$n = 38.56 \times 61.44 \times [1.96/8]^2$

n= 142.21 (rounded to 142)

Therefore 142 is the sample size required for the study assuming 80% as the power of study.

METHODOLOGY

Approval from the Institutional scientific and Ethical committee of Government Kilpauk Medical College and Hospital Chennai was obtained. Newborns delivered in Kilpauk Medical College and hospital who satisfy the inclusion criteria were included in the study. The parents were given counseling and informed consent was obtained from them for investigation and enrollment into the study. If at any point of time newborn was found to have parameters in the exclusion criteria then that newborn was excluded from the study.

Under strict aseptic precautions cord blood samples and peripheral blood samples within 1 hour of birth were collected in a EDTA tube from all newborns who satisfies inclusion criteria for analysis of total count, absolute neutrophil count, immature to total neutrophil ratio, platelet count and micro ESR .

Under strict aseptic precautions, 2 ml of peripheral blood for blood culture was collected, since blood culture is the gold standard to diagnose sepsis.

These newborns were followed up for three days to look for development of features of clinical sepsis.

PRINCIPLE

- Automated six part analyser was used to measure the blood counts.
- Micro ESR was estimated using capillary tube method**.**

STATISTICAL ANALYSIS

Data was recorded on MS Excel sheets and analysis has been made as given below,

Descriptive analysis: Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency, and proportion for categorical variables. Data was also represented using appropriate diagrams like bar diagram, pie diagram, and box plots.

Inferential statistics

Quantitative outcome

The association between categorical explanatory variables and the quantitative outcome was assessed by comparing the mean values. The mean differences along with their 95% CI were presented. Independent sample t-test/ ANOVA/Paired t- test was used to assess statistical significance. Association between quantitative explanatory and outcome variables was assessed by calculating person correlation coefficient and the data was represented in a scatter diagram.

Categorical outcome

The association between explanatory variables and categorical outcomes was assessed by cross tabulation and comparison of percentages. Odds ratio along with 95% CI are presented. Chi square test was used to test statistical significance.

P value < 0.05 was considered statistically significant. IBM SPSS version 22 was used for statistical analysis.

RESULTS AND ANALYSIS

The study was conducted in Government Kilpauk medical college. The neonates who were satisfied with the inclusion criteria were included. The study was done in 142 neonates who were born in Govt Kilpauk medical college hospital during the period of April 2017 to September 2017.

RESULTS

A total of 142 subjects were included in the analysis**.**

TABLE 1 : descriptive analysis of gender in study population (n = 142)

Gender	Frequency	Percentage
Male	83	58.45%
Female	59	41.55%

Among the study population, male were 83 (58.45%) and female were 59 (41.55%).table 1

Figure 1: Bar chart of Gender distribution in study population (N=142)

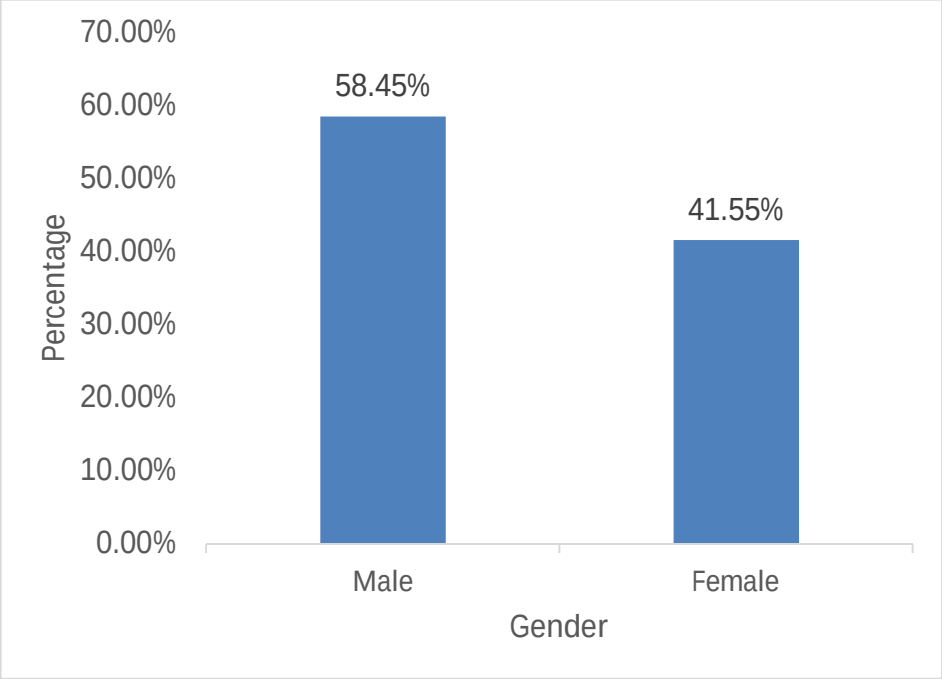


Table 2

Association of Clinical Sepsis with Gender of study population (N=142)

Gender	Clinical Sepsis		Chi square	P-value
	Present	Absent		
Male	22 (53.66%)	61 (60.4%)	0.545	0.460
Female	19 (46.34%)	40 (39.6%)		

Among the clinical sepsis, male were 22 (53.66%) and female were 19 (46.34%). (table 2)

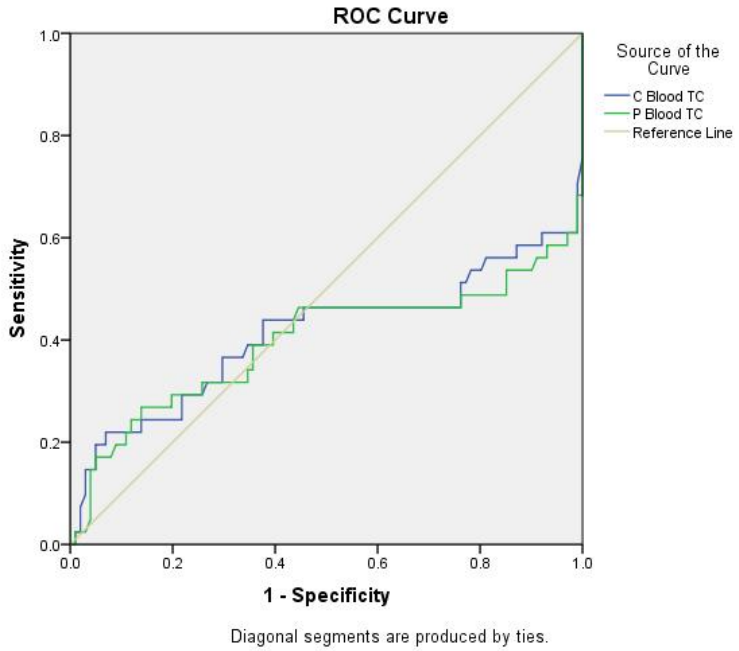
Table 3

Descriptive analysis for birth weight kg in study population (N=142)

Parameter	Mean ±STD	Median	Min	Max	95% C.I. for EXP(B)	
					Lower	Upper
Birth weight kg	2.19 ± 0.55	2.17	1.04	3.78	2.10	2.28

The mean birth weight of study population was 2.19 with minimum 1.04 kg and maximum 3.78 kg. (95% CI 2.10 to 2.28). (Table 3)

Figure 2: Comparision of predictive value of cord blood and peripheral blood TC



Area Under the Curve

Test Result Variable(s)	Area Under the curve	Std. Error[a]	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval	
				Lower Bound	Upper Bound
C Blood TC	.411	.065	.099	.284	.538
P Blood TC	.397	.065	.054	.269	.524

The test result variable(s): C Blood TC, P Blood TC has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.

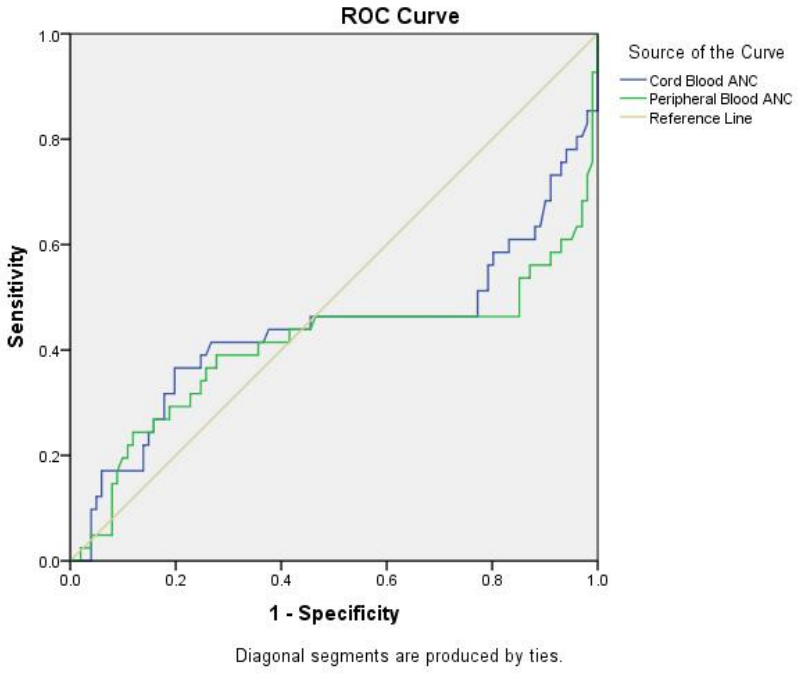
a. Under the nonparametric assumption

b. Null hypothesis: true area = 0.5

The predictive validity of both the cord blood and peripheral blood TC in predicting sepsis were poor (Area under the curve 0.41 and0.397, for cord blood and peripheral blood respectively). Both the values were statistically not significant.(P value > 0.05)

Figure 3:

Comparison of predictive validity of Cord blood and Peripheral Blood ANC



Test Result Variable(s)	Area Under the Curve (AUC)	Std. Error	95% Confidence Interval of AUC		P-value
			Lower Bound	Upper Bound	
Cord Blood ANC	0.438	0.063	0.314	0.562	0.247

Peripheral Blood ANC	0.404	0.064	0.278	0.531	0.075

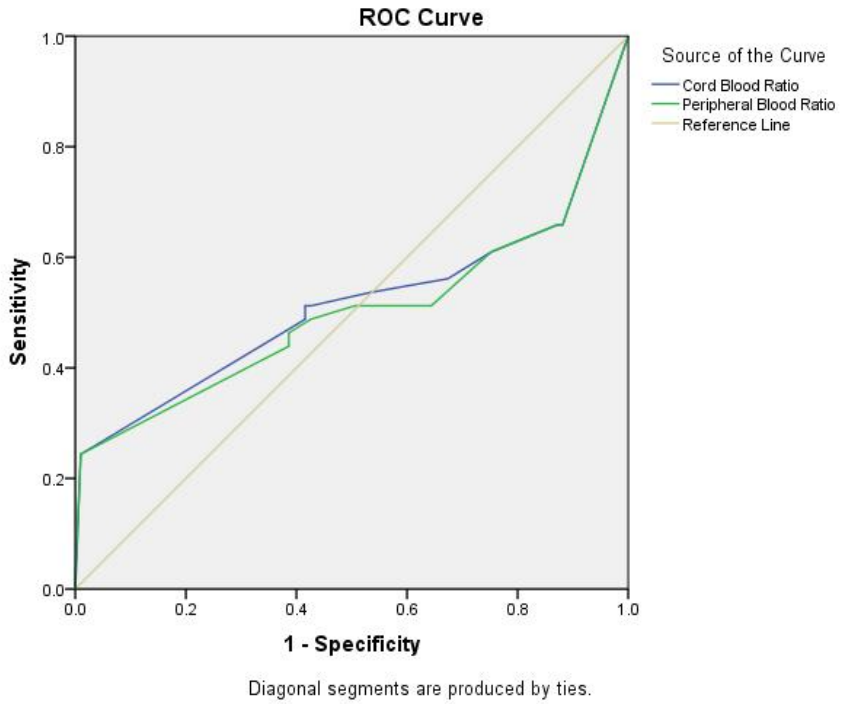
Any Blood predictive value more than 0.7 good predictive validity in predicting clinical sepsis.

The Cord blood ANC had poor predictive validity in predicting clinical sepsis,as indicated by area under the curve of 0.438 (95% CI 0.314 to 0.562, p value 0.247)

The Peripheral Blood ANC had poor predictive validity in predicting clinical sepsis,as indicated by area under the curve of 0.404 (95% CI 0.278 to 0.531, p value 0.075).

Figure 4:

Comparison of predictive validity of Cord blood and Peripheral Blood I/T Ratio.



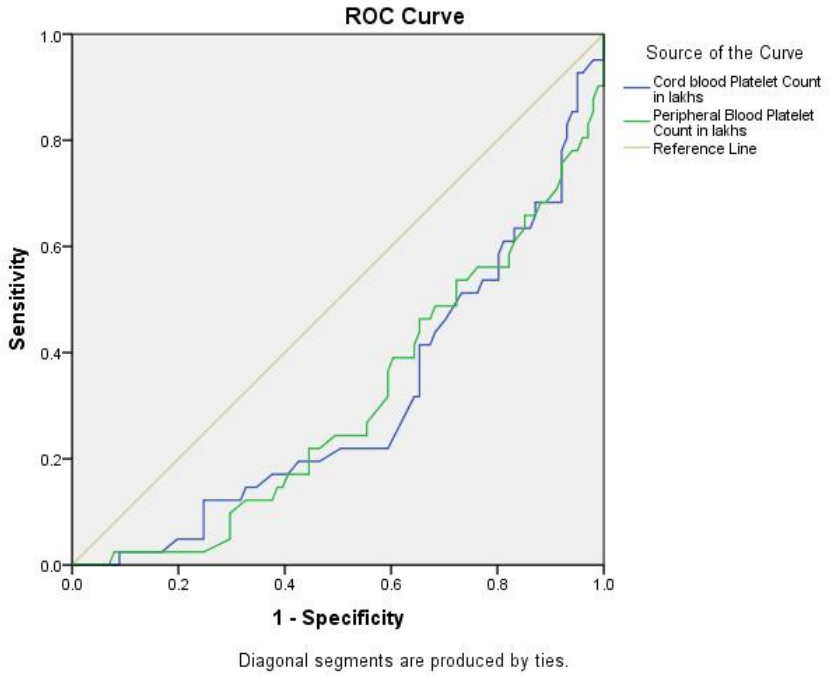
Test Result Variable(s)	Area Under the Curve (AUC)	Std. Error	95% Confidence Interval of AUC		P-value
			Lower Bound	Upper Bound	
Cord Blood Ratio	0.515	0.064	0.389	0.641	0.784
Peripheral Blood Ratio	0.501	0.064	0.375	0.626	0.989

Any Blood predictive value more than 0.7 good predictive validity in predicting clinical sepsis.

The Cord blood I/T Ratio had poor predictive validity in predicting clinical sepsis,as indicated by area under the curve of 0.515 (95% CI 0.389 to 0.641, p value 0.784)

The Peripheral Blood I/T Ratio had poor predictive validity in predicting clinical sepsis,as indicated by area under the curve of 0.501 (95% CI 0.375 to 0.626, p value 0.989).

Figure 5: Comparison of predictive validity of Cord blood and Peripheral



Blood Platelet count

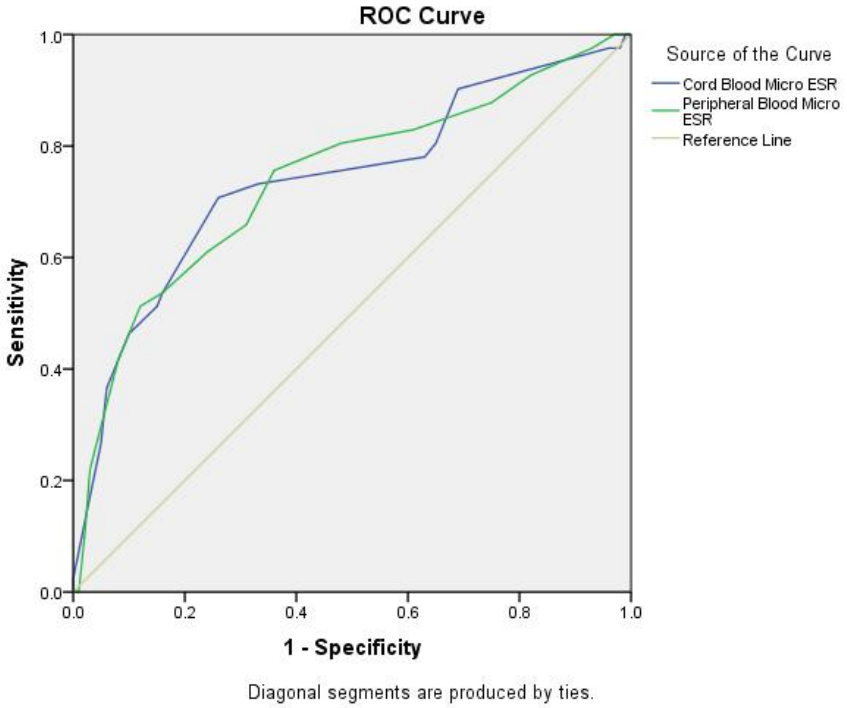
Test Result Variable(s)	Area Under the Curve (AUC)	Std. Error	95% Confidence Interval of AUC		P-value
			Lower Bound	Upper Bound	
Cord blood Platelet Count in lakhs	0.304	0.048	0.210	0.398	<0.001
Peripheral Blood Platelet Count in lakhs	0.306	0.047	0.213	0.398	<0.001

Any Blood predictive value more than 0.7 good predictive validity in predicting clinical sepsis.

The Cord blood Platelet count had poor predictive validity in predicting clinical sepsis, as indicated by area under the curve of 0.304 (95% CI 0.210 to 0.398, p value <0.001)

The Peripheral Blood Platelet count had poor predictive validity in predicting clinical sepsis, as indicated by area under the curve of 0.306 (95% CI 0.213 to 0.398, p value<0.001).

Figure 6: Comparison of predictive validity of Cord blood and Peripheral Blood Micro ESR



Test Result Variable(s)	Area Under the Curve(AUC)	Std. Error	95% Confidence Interval of AUC		P-value
			Lower Bound	Upper Bound	
Cord Blood Micro ESR	0.739	0.050	0.641	0.837	<0.001
Peripheral Blood Micro ESR	0.740	0.049	0.643	0.836	<0.001

Any Blood predictive value more than 0.7 good predictive validity in predicting clinical sepsis.

The Cord blood Micro ESR had good predictive validity in predicting clinical sepsis,as indicated by area under the curve of 0.739 (95% CI 0.641 to 0.837, p value<0.001).

The Peripheral Blood Micro ESR had good predictive validity in predicting clinical sepsis,as indicated by area under the curve of 0.740 (95% CI 0.643 to 0.836, p value<0.001)

Table 4

Descriptive analysis of Clinical Sepsis in study population (N=142)

ClinicalSepsis	Frequency	Percentage
Present	41	28.87%
Absent	101	71.13%

Among the study group, 41 babies (28.87%) had clinical sepsis and 101 babies (71.13%) don't have clinical sepsis.

Figure 7

Pie chart of clinical sepsis in study population

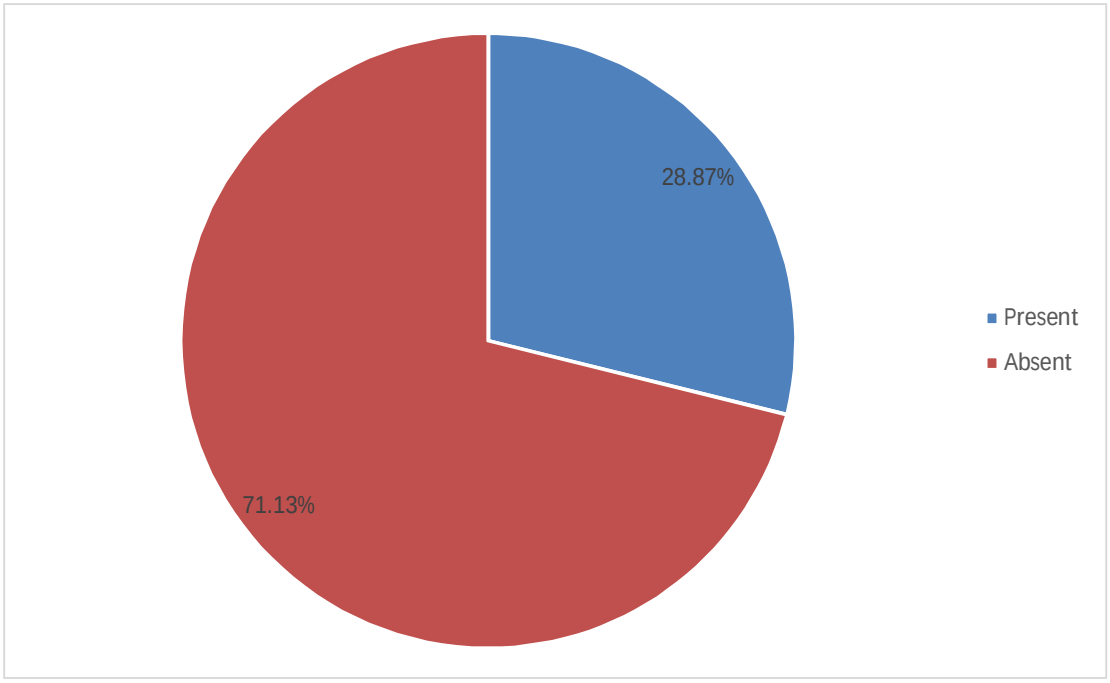


Table 5 :Descriptive analysis of Blood CS in study population (N=142)

Blood CS	Frequency	Percent
NG	120	84.51%
staph aureus	10	7.04%
pseudomonas	5	3.52%
klebsiella	4	2.82%
enterococci	2	1.41%
CONS	1	0.70%

In this study, staphylococcus aureus was the most common organism isolated from the blood culture.

Table 6: Association of clinical sepsis with blood culture of study population

Blood CS	ClinicalSepsis	
	Present	**Absent**
CONS	0 (0%)	1 (0.99%)
enterococci	2 (4.88%)	0 (0%)
klebsiella	4 (9.76%)	0 (0%)
NG	20 (48.78%)	100 (99.01%)
pseudomonas	5 (12.2%)	0 (0%)
staph aureus	10 (24.39%)	0 (0%)

Among the clinical sepsis,21 babies (51.23%) had positive blood culture and 20 babies (48.77%) had negative blood culture

Table 7:

Comparison of mean of various parameters with clinical sepsis across study groups (N=142)

Parameter	Mean ±SD		P value
	Present (N=41)	Absent (N=101)	
C Blood TC	11736.59±17077.08	10222.99±3673.13	*.398*
P Blood TC	9273.73 ± 5609.9	10406.72 ± 3580.3	*.153*
C Blood ANC	7697.9 ± 14396.04	6023.48 ± 3051.41	*.267*
P Blood ANC	5596.29 ± 3954.39	6243.51 ± 2964.91	*.288*
C Blood Ratio	0.08 ± 0.08	0.05 ± 0.04	*.024*
P Blood Ratio	0.08 ± 0.09	0.05 ± 0.04	*.024*
C blood Platelet Count in lakhs	1.76 ± 0.56	2.17 ± 0.61	*<0.001*
P Blood Platelet Count in lakhs	1.78 ± 0.62	2.22 ± 0.58	*<0.001*
C Blood Micro ESR	13 ± 3.83	9.88 ± 3.14	*<0.001*
P Blood Micro ESR	13.22 ± 3.88	10.02 ± 3.87	*<0.001*

Table 8

Comparison of mean Lab parameter across study groups (N=142)

Lab Parameter	Cord Blood	Peripheral Blood	P-value
Total count	10660.01 ± 9631.9	10079.59 ± 4276.05	0.414
ANC	5909.89 ± 3339.22	6056.64 ± 3279.83	0.021
I/T Ratio	0.06 ± 0.06	0.06 ± 0.06	0.396
Micro ESR	10.79 ± 3.63	10.93 ± 4.14	0.471
Platelet Count in lakhs	2.05 ± 0.62	2.09 ± 0.63	0.172

The mean Cord Blood total count was 10660.01 ± 9631.9 and in peripheral blood total count, it was10079.59 ± 4276.05, the difference in total count between the two groups was statistically not significant (p value 0.414).

The mean Cord Blood ANC was 5909.89 ± 3339.22 and in peripheral blood ANC it was 6056.64 ± 3279.83 , the difference in ANC between the two groups was statistically significant (p value 0.031).

The mean Cord Blood I/T Ratio was 0.06 ± 0.06 and in peripheral blood I/T Ratio it was 0.06 ± 0.06 ,the difference in I/T Ratio between the two groups was statistically not significant (p value 0.396).

The mean Cord Blood MicroESR was 10.79 ± 3.63 and in peripheral blood MicroESR it was 10.93 ± 4.14 , the difference in MicroESR between the two groups was statistically not significant (p value 0.471).

The mean Cord Blood platelet count was 2.05 ± 0.62 and in peripheral blood platelet count it was 2.09 ± 0.63 , the difference in platelet count between the two groups was statistically not significant (p value 0.172).

DISCUSSION

This study was conducted in Government Kilpauk Medical College Chennai.This is a tertiary care teaching centre.

Our study population comprises 142 newborns born in Govt Kilpauk Medical College Hospital. Out of 142 babies 91 were female babies and 89 were male babies .In the present study no statistically significant difference (p value 0.426) was found between gender of the baby and clinical sepsis.

Out of 142 babies ,41 babies developed features of clinical sepsis and among them 21 babies had positive blood culture.

Among the 142 neonates, the predictive validity of TC in both cord and peripheral blood were poor in diagnosing clinical sepsis (Area under the curve 0.41 and0.397, for cord blood and peripheral blood respectively). Both the values were statistically not significant.(P value > 0.05) .

Madhava R. Beeram, et al (31) in their study 2011 found a similar poor correlation of total count in both cord and peripheral blood in sepsis screening. (6% in UCB vs 1.2% in peripheral blood, *P* = .02).

Richard A. Polin et al (32) in their study found that Total white blood cell counts have little value in the diagnosis of early-onset sepsis and have a poor positive predictive accuracy.

Christensen RD et al and Engle WD et al also found poor predictivity of total count in diagnosis of early onset sepsis. .(33,34).

Jahnke et al and Weitzman M et al in their study, Blood leukocytes count in the newborn babies have been considered to be so variable and unpredictable as to be of little value for clinical diagnosis.(35,36).

Out of the 142 babies, The Cord blood ANC had poor predictive validity in predicting clinical sepsis, as indicated by area under the curve of 0.438 (95% CI 0.314 to 0.562, p value 0.247) The Peripheral Blood ANC had poor predictive validity in predicting clinical sepsis, as indicated by area under the curve of 0.404 (95% CI 0.278 to 0.531, p value 0.075).

Christoph P. Hornik et al in their study found a poor predictive validity of ANC in diagnosing early onset sepsis. (AUC=0.586 in ROC CURVE)(33).

Among the 142 babies. Both the cord and peripheral blood I/T Ratio in predicting clinical sepsis were poor (area under the curve of 0.515 (95% CI 0.389 to 0.641, p value 0.784 and area under the curve of 0.501 (95% CI 0.375 to 0.626, p value 0.989).

Christoph P. Hornik, et al in 2012 in their study concluded that I/T cut-offs were associated with relatively high specificities (73.7%, 81.7%, 95.7%, respectively) and negative predictive values (99.2%, 99.2%, 99.0%, respectively), but positive predictive values were low (2.5%, 3.2%, 6.0%, respectively) in the setting of a low overall proportion of positive culture(33).

Bhandari v et al also found poor predictive validity of cord blood I/T Ratio in diagnosing sepsis.(37).

The Cord blood Platelet count had poor predictive validity in predicting clinical sepsis,as indicated by area under the curve of 0.304 (95% CI 0.210 to 0.398, p value <0.001).

The Peripheral Blood Platelet count had poor predictive validity in predicting clinical sepsis, as indicated by area under the curve of 0.306 (95% CI 0.213 to 0.398, p value<0.001.

Khair KB[1],et al in 2012 in their study , platelet count were found to have optimal sensitivities and negative predictive value in diagnosing sepsis in neonates .(38).

Keren Rotshenker-OlshinkaD et al in 2014 found a significant correlation between umbilical cord and peripheral venous samples in platelets count (PLT) ($r = 0.54$) in diagnosing sepsis in newborn.(39).

The Cord blood Micro ESR had good predictive validity in predicting clinical sepsis,as indicated by area under the curve of 0.739 (95% CI 0.641 to 0.837, p value<0.001) .The Peripheral Blood Micro ESR had good predictive validity in predicting clinical sepsis, as indicated by area under the curve of 0.740 (95% CI 0.643 to 0.836, p value<0.001).

Vamseedar annam et al in 2015, had similar results of good predictivity of both cord and peripheral blood micro ESR in clinical sepsis with a p value < 0.001.(1)

Similarly Walliullah SM et al in his study found good sensitivity of micro ESR in diagnosing early onset sepsis.(40).

LIMITATION OF THE STUDY

- This study was done in a smaller population, so the predictivity validity of haematological indices in diagnosing early onset neonatal sepsis is less.
- In this study, cumulative value of haematological indices in predicting early neonatal sepsis was not analysed .

CONCLUSION

In the present study it was concluded that cord blood micro ESR can be used in sepsis screening to predict the neonates at risk for developing early onset sepsis instead of peripheral blood with a good positive predictive value(p value < 0.001).

Cord blood platelet count has good correlation with peripheral blood platelet count (p value < 0.001) but has poor predictivity in diagnosing early onset sepsis.

No statistically significant correlation was found between cord blood and peripheral blood Total count, ANC and I/T Ratio.

Both cord and peripheral blood Total count, ANC and I/T Ratio has poor predictive value in diagnosing early onset sepsis.

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PROFORMA

Case no: **IP no :**

Name:

Age/sex:

Address:

HISTORY:

1. Prematurity / low birth weight < 2500 gm
2. Maternal fever > 100.4 *C
3. Foul smelling liquor
4. Duration of rupture of membrane
5. Prolonged labour (sumof 1st and 2nd stage of labour > 24 hours)
6. No of vaginal examination during labour

GENERAL EXAMINATION:

Vitals: **HR:** **RR:**

ANTHROPOMETRY:

Weight:
Length:
Head circumference:

HEAD TO FOOT EXAMINATION :

SYSTEMIC EXAMINATION:

CVS: **RS:**

P/A: **CNS:**

INVESTIGATION:

COMPLET E BLOOD COUNT

TC:

ABSOLUTE NEUTROPHIL COUNT:

IMMATURE NEUTROPHIL COUNT:

I/T RATIO:

PLATELET COUNT:

MICRO ESR:

BLOOD CULTURE AND SENSITIVITY:

IMPRESSION:

NAME & SIGNATURE OF THE GUIDE **NAME & SIGNATURE OF THE STUDENT**

சுயஒப்புதல் படிவம்

ஆய்வு செய்யப்படும் தலைப்பு: ©¸zxÁUPÀ¿¶ ©¸zxÁ©øÚ°À ¤ÓUS®£a]Í®SÇ¢øu°ß öuõ¨¦Ò öPõi Cµzu®©ØÖ®SÇ¢øu°ß Cµzuzvà ÷{õ´Q¸ª uõUSu»õÀ HØ£k® ©õØÓ[PøÍ B´Ä ÷©ØöPõÒÐuÀ öuõhº£õÚ B´Ä

இடம்¦ அரசு கீழ்பாக்கம் மருத்துவ கல்லூரி மருத்துவமனை
சென்னை

பங்குபெறுபவரின் பெயர் :

பங்குபெறுபவரின் வயது : **பங்குபெறுபவரின் எண் :**

மேலே குறிப்பிட்டுள்ள மருத்துவ ஆய்வின் விவரங்கள் எனக்கு விளக்கப்பட்டது. நான் இவ்வாய்வில் தன்னிச்சையாக பங்கேற்கிறேன். எந்த காரணத்தினாலோ எந்த சட்டசிக்கலுக்கும் உட்படாமல் நான் இவ்வாய்வில் இருந்து விலகிக்கொள்ளல்லாம் என்றும் அறிந்து கொண்டேன்.

இந்த ஆய்வு சம்பந்தமாகவோ, இதை சார்ந்து மேலும் ஆய்வு மேற்கொள்ளும்போதும் இந்த ஆய்வில்பங்கு பெறும் மருத்துவர் என்னுடைய மருத்துவ அறிக்கைகளை பார்ப்பதற்கு என் அனுமதி தேவையில்லை என அறிந்து கொள்கிறேன். இந்த ஆய்வின் மூலம் கிடைக்கும் தகவலையோ, முடிவையோ பயன்படுத்திக்கொள்ள மறுக்க மாட்டேன்.

இந்த ஆய்வில் பங்கு கொள்ள ஒப்புக்கொள்கிறேன். இந்த ஆய்வை மேற்கொள்ளும் மருத்துவ அணிக்கு உண்மையுடன் இருப்பேன் என்றும் உறுதியளிக்கிறேன்.

ö£õØ÷Óõ¶ß கையொப்பம் ஆய்வாளரின் கையொப்பம

இடம் :

தேதி :

PATIENT CONSENT FORM

Study detail "**COMPARATIVE STUDY OF HAEMATOLOGICAL INDICES IN CORD BLOOD VS PERIPHERAL VENOUS BLOOD IN PREDICTING EARLY ONSET NEONATAL SEPSIS**"

Study centre : KILPAUK MEDICAL COLLEGE, CHENNAI

Patients Name :

Patients Age :

Identification Number :

Patient may check ( ) these boxes ✓

I confirm that I have understood the purpose of procedure for the above study. I have the opportunity to ask question and all my questions and doubts have been answered to my complete satisfaction. ☐

I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving reason, without my legal rights being affected. ☐

I understand that sponsor of the clinical study, others working on the sponsor's behalf, the ethical committee and the regulatory authorities will not need my permission to look at my health records, both in respect of current study and any ☐

further research that may be conducted in relation to it, even if I withdraw from the study I agree to this access. However, I understand that my identity will not be revealed in any information released to third parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from this study.

I agree to take part in the above study and to comply with the instructions given during the study and faithfully cooperate with the study team and to imm☐tely inform the study staff if I suffer from any deterioration in my health or well-being or any unexpected or unusual symptoms.

I hereby consent to participate in this study.

I hereby give permission to undergo complete clinical examination and diagnostic ☐ tests including hematological, biochemical, radiological tests.

Signature/thumb impression:

Patients Name and Address: place date

Signature of investigator :

Study investigator's Name : place date

INSTITUTIONAL ETHICS COMMITTEE
GOVT. KILPAUK MEDICAL COLLEGE,
CHENNAI-10
Protocol ID. No.14/2017 Meeting held on 17.04.2017

The Institutional Ethical Committee of Govt. Kilpauk Medical College, Chennai reviewed and discussed the application for approval "**Comparative study of Hematological induces in cord blood vs peripheral venous blood in predicting early onset neonatal sepsis**" submitted by Dr.P.Mahalakshmi, M.D. (Paediatrics), PG Student, GKMC, Chennai-10

The Proposal is APPROVED

The Institutional Ethical Committee expects to be informed about the progress of the study any Adverse Drug Reaction Occurring in the Course of the study any change in the protocol and patient information /informed consent and asks to be provided a copy of the final report.

28.4.2017.

DEAN
Govt. Kilpauk Medical College,
Chennai-10.

26/4/17

My Comp<E Colon< ME 1 Sec> Ethical Committee

ABBREVIATIONS

EOS	-	Early onset sepsis
LOS	-	Late onset sepsis
ANC	-	Absolute neutrophil count
I/T Ratio	-	Immature to Total neutrophil Ratio
DIC	-	Disseminated intravascular coagulation
aPTT	-	Activated partial thromboplastin time
CSF	-	Cerebrospinal fluid
NEC	-	Necrotising enterocolitis.

Sl. No	IP no.	Name	Age	Sex	B.Wt(kg)	TC (Cells/Cumm)		DC (N/L/M/E)		ANC (P/A)		Immature Neutr.		I/T Ratio		Platelet Count in lakhs		Micro ESR (mm)		Clinical Sepsis		Blood C/S
						C Blood	P Blood	C blood	P Blood	C Blood	P Blood	C blood	P Blood	C Blood	P Blood	C blood	P Blood	C Blood	P Blood	Y/N	HOL	
1	18138	B/O Surya	1/365	M	2.13	16500/0	17590/0	59/25/15/0	66/23/11/0	9810/A	11590/A	200	290	0.02/0	0.02/0	2.7/0	2.6/0	7/A	4/A	absent		NG
2	18188	B/O Amudha	1/365	M	3.42	5330/0	6550/0	40/44/10/0	53/32/10	2160/A	3490/A	400	90	0.1/0	0.02/0	2.2/0	2.1/0	7/A	8/A	absent		NG
3	18271	B/O Sasikala	1/365	M	2.3	11820/0	12920/0	64/23/13/0	64/25/11/0	7580/A	7100/A	240	260	0.03/0	0.03/0	1.81/0	1.64/0	4/A	6/A	absent		NG
4	18424	B/O Radhika	1/365	F	1.86	11070/0	9300/o	72/20/8/0	60/25/15/0	7290/A	5990/A	80	190	0.01/0	0.03/0	`3.0/0	`3.0/0	3/A	3/A	absent		NG
5	18403	B/O Salomi	1/365	M	1.96	4240/1	4450/1	54/36/10/0	52/35/13/0	2260/A	2310/A	60	60	0.02/0	0.02/0	2.4/0	2.29/0	4/A	5/A	present	26 hrs	NG
6	18802	B/O Tamil	1/365	M	2.68	11400/0	10300/0	58/29/13/0	58/29/13/0	6590/A	5900/A	550	460	0.08/0	0.07/0	1.19/0	1.38/1	7/A	8/A	present	16 hrs	staph aureus
7	18914	B/O Ganga	1/365	M	1.52	12420/0	14300/0	72/22/6/0	66/30/4/0	8890/A	9430/A	200	230	0.02/0	0.02/0	1.3/0	1.83/0	8/A	7/A	present	50 hrs	NG
8	19026	B/O Sandiya	1/365	M	2.64	5320/0	8270/o	59/27/13/0	57/26/17/0	3130/A	4700/A	50	280	0.01/0	0.05/0	1.7/0	1.5/1	13/A	12/A	absent		NG
9	19183	B/O Padma	1/365	M	1.98	11800/0	12940/0	60/32/8/0	66/32/2/0	7430/A	8210/A	200	260	0.02/0	0.03/0	1.78/0	1.6/0	10/A	12/A	absent		NG
10	19279	B/O Manisha	1/365	M	2.69	9500/0	9520/0	65/25/10/0	66/24/10/0	6110/A	6560/A	420	280	0.06/0	0.04/0	0.88/1	0.95/1	7/A	6/A	absent		NG
11	19467	B/O Priyanka	1/365	M	1.68	10700/0	11000/0	35/50/15/0	40/45/15/0	4857/A	4400/A	70	68	0.01/0	0.01/0	2.66/0	2.72/0	7/A	8/A	absent		NG
12	20138	B/O Jayanthi	1/365	F	1.52	20210/0	19320/0	59/35/6/0	57/27/13/3	11820/A	11080/A	1270	1210	0.1/0	0.1/0	2.6/0	2.61/0	16/P	15/P	present	6 hrs	staph aureus
13	20292	B/O Nasimal	1/365	M	1.54	3840/1	6670/0	22/74/4/0	40/53/7/0	850/P	2660/A	50	60	0.1/0	0.05/0	1.98/0	2.12/0	15/P	17/P	present	40 hrs	NG
14	20652	b/o sangeetha	1/365	M	2.3	12720/0	11760/0	70/26/4/0	68/20/10/2	9158/A	7996/A	1278	1372	`0.1/0	`0.1/0	1.06/1	`0.98/1	16/P	17/P	present	12 hrs	NG
15	21292	b/o sathyapriya	1/365	M	2.12	13100/0	11148/0	77/15/8/0	75/22/3/0	7740/A	6810/A	150	90	`0.01/0	`0.01/0	`0.80/1	`0.83/1	12/A	10/A	present	56 hrs	NG
16	21364	b/o sangeetha	1/365	M	1..93	11800/0	11920/0	75/26/4/0	74/20/6/0	8850/A	8208/A	240	210	`0.02/0	`0.02/0	1.08/1	1.02/1	8/A	10/A	present	44 hrs	staph aureus
17	21424	b/o latha A	1/365	F	2.07	9670/0	10577/0	57/26/12/5	60/25/15/0	5690/A	6270/A	110	140	`0.01/0	`0.02/0	2.48/0	2.76/0	12/A	15/P	absent		NG
18	21426	b/o latha B	1/365	M	2.27	5720/0	7270/0	35/60/5/0	50/42/8/0	2010/A	3635/A	100	80	`0.04/0	`0.02/0	1.5/1	2.24/0	8/A	10/A	absent		NG
19	22527	b/o kalpana	1/365	M	2.77	10720/0	11200/0	50/35/14/1	55/35/15/0	5360/A	6160/A	70	86	`0.02/0	`0.01/0	2.66/0	2.72/0	8/A	7/A	absent		NG
20	22670	b/o varalaxmi	1/365	F	2.19	14270/0	12450/0	65/34/11/0	70/22/8/0	9430/A	8970/A	230	200	`0.02/0	`0.03/0	1.86/0	1.9/0	7/A	6/A	absent		NG
21	22834	b/o bhuvana	1/365	F	2.8	12520/0	12430/0	65/24/11/0	64/25/9/2	8150/A	7920/A	260	220	`0.03/0	`0.02/0	2.16/0	2.26/0	7/A	8/A	absent		NG
22	23119	b/o sonali B	1/365	F	1.52	12910/0	12670/0	66/31/3/0	64/33/3/0	7521/A	7126/A	410	240	`0.1/0	`0.03/0	2.29/0	2.39/0	7/A	9/A	absent		NG
23	23520	b/o chitra A	1/365	F	1.88	5720/0	7273/0	33/55/9/0	57/30/13/0	2012/A	2410/A	100	80	`0.04/0	`0.03/0	2.18/0	1.88/0	6/A	8/A	absent		NG
24	23521	b/o chitra B	1/365	F	1.67	11710/0	12530/0	66/26/8/0	64/28/8/0	8158/A	7926/A	370	380	`0.04/0	`0.04/0	2.29/0	2.37/0	9/A	8/A	present	22 hrs	NG
25	23936	b/o sarasu	1/365	M	2.43	5210/0	5920/0	65/30/5/0	68/28/4/0	3386/A	4025/A	420	470	`0.1/0	`0.1/0	2.12/0	2.18/0	7/A	8/A	absent		NG
26	24130	b/o nadhiya	1/365	M	3.02	6680/0	7106/0	35/55/10/0	37/55/12/0	2320/A	2630/A	150	160	`0.1/0	`0.1/0	1.38/1	2.2/0	5/A	6/A	absent		NG

27	24157	b/o darshini	1/365	M	1.76	17650/0	17655/0	64/33/3/0	66/30/4/0	11210/A	11510/A	2470	2240	`0.2/1	`0.1/0	1.08/1	1.28/1	11/A	13/A	present	32 hrs	enterococci
28	24228	B/O JAYANTHI	1/365	M	2.66	9942/0	9420/0	32/56/12/0	31/51/15/3	3102/A	2870/A	120	110	`0.03/0	`0.03/0	3.72/0	3.62/0	6/A	8/A	absent		NG
29	27100	b/o jesina	1/365	M	3.07	6170/0	5630/0	53/23/10/13	50/23/10/14	3250/A	2810/A	392	600	`0.1/0	`0.2/1	1.43/1	1.32/1	8/A	9/A	present	50 hrs	pseudomonas
30	27121	b/o pallavi	1/365	F	2.46	12020/0	12900/0	63/23/13/0	61/22/15/2	7500/A	7850/A	220	170	`0.02/0	`0.02/0	1.58/0	2.05/0	9/A	7/A	absent		NG
31	27123	b/o nathiya	1/365	F	1.9	12530/0	12430/0	65/24/10/2	64/26/10/0	8150/A	7920/A	360	380	0.04/0	0.04/0	2.29/0	2.37/0	12/A	13/A	absent		NG
32	27315	b/o dhanalakshmi	1/365	M	2.33	17550/0	17670/0	64/32/4/0	65/32/3/0	11220/A	11510/A	2220	4100	0.2/1	0.3/1	2.42/0	2.29/0	13/A	12/A	present	20 hrs	NG
33	27369	b/o dhivya	1/365	M	3.78	6690/0	7210/0	65/30/5/0	62/32/6/0	4348/A	4470/A	310	328	0.1/0	0.1/0	2.42/0	2.18/0	10/A	13/A	absent		NG
34	27484	b/o muthuselvi	1/365	M	2.17	13050/0	12510/0	71/21.8/0	72/24/2/0	9230/A	8210/A	280	320	0.03/0	0.03/0	1.46/1	1.56/0	6/A	4/A	absent		NG
35	27443	b/o amudha	1/365	M	3.1	6690/0	6720/0	30/50/12/8	32/56/12/0	2010/A	2102/A	340	370	0.2/1	0.2/1	1.98/0	1.82/0	8/A	6/A	present	36 hrs	pseudomonas
36	27830	b/o dhivya	1/365	F	2.84	20890/0	21090/0	75/15/10/0	76/13/11/0	15660/A	15960/A	560	660	0.03/0	0.03/0	2.22/0	2.27/0	10/A	9/A	absent		NG
37	27870	b/o vanaroja	1/365	M	1.91	13160/0	13250/0	45/50/5/0	44/45/11/0	5210/A	5770/A	180	110	0.03/0	0.01/0	2.2/0	1.72/0	6/A	7/A	absent		NG
38	28015	b/o rajalakshmi	1/365	M	1.92	15370/0	15840/0	69/19/12/0	64/19/17/0	10510/A	10010/A	150	158	0.01/0	0.01/0	2.0/0	1.66/0	9/A	10/A	absent		NG
39	27890	b/o naagammal	1/365	M	2.16	14080/0	14520/0	51/36/13/0	53/35/12/0	7150/A	7570/A	700	660	0.1/0	0.1/0	3.06/0	2.87/0	6/A	5/A	absent		NG
40	28019	b/o tamilarasi	1/365	F	1.64	10150/0	10320/0	59/28/13/0	60/26/14/0	5910/A	6150/A	100	150	0.01/0	0.02/0	1.24/1	1.16/1	7/A	6/A	present	32 hrs	NG
41	28035	b/o shailaja	1/365	M	2.25	18910/0	18710/0	78/13.9/0	79/15/6/0	14710/A	14670/A	340	330	0.02/0	0.02/0	1.82/0	1.69/0	7/A	5/A	absent		NG
42	28252	b/o sangeetha	1/365	F	2.26	5690/0	5850/0	55/30/15/0	58/32/10/0	3100/A	3260/A	500	560	0.2/1	0.2/1	1.52/0	1.44/1	12/A	15/P	present	20 hrs	pseudomonas
43	28398	b/o janani	1/365	F	1.84	14900/0	13800/0	71/20.9/0	68/30/2/0	10540/A	9380/A	300	80	0.02/0	0.01/0	0.87/1	1.02/1	7/A	10/A	absent		NG
44	28546	b/o jenifer A	1/365	F	1.73	8790/0	8580/0	39/49/12/0	45/43/12/0	3380/A	3820/A	140	90	0.04/0	0.02/0	1.02/1	2.25/0	7/A	8/A	absent		NG
45	28547	b/o jenifer B	1/365	F	2.03	6650/0	7100/0	35/55/10/0	38/56/4/0	2300/A	2640/A	150	150	0.1/0	0.1/0	1.35/1	2.22/0	10/A	11/A	absent		NG
46	28563	b/o bijipriya B	1/365	F	2.34	7900/0	8600/0	65/18/18/1	65/18/19/0	5160/A	5630/A	520	410	0.1/0	0.1/0	1.33/1	1.21/1	15/P	15/P	absent		NG
47	27046	b/o ponsugi	1/365	F	3.16	16150/0	16890/0	70/18/12/0	70/20/10/0	11240/A	11760/A	520	536	0.1/0	0.03/0	2.55/0	2.59/0	10/A	9/A	absent		NG
48	29067	b/o nagamani	1/365	M	1.84	2460/1	2440/1	38/52/10/0	37/51/12/0	920/P	800/P	150	160	0.2/1	0.2/1	1.23/1	1.59/0	17/P	18/P	present	34 hrs	NG
49	29065	b/o rajakumari	1/365	F	2.43	7220/0	8119/0	60/26/14/0	55/27/16/0	4280/A	4570/A	80	180	0.01/0	0.03/0	2.28/0	1.94/0	10/A	11/A	absent		NG
50	29259	b/o ramya	1/365	M	2.38	8000/0	8440/0	52/38/10/0	56/36/8/0	4140/A	4650/A	130	240	0.03/0	0.1/0	1.34/1	1.48/1	10/A	8/A	absent		NG
51	29518	b/o gayathri	1/365	F	2.86	15470/0	17510/0	68/20/12/0	69/18/3/0	10380/A	11790/A	350	460	0.03/0	0.2/1	2.53/0	2.35/0	10/A	9/A	absent		NG
52	1428	b/o vanitha	1/365	M	2.61	13250/0	12640/0	66/20/10/4	65/19/16/0	8720/A	8160/A	40	50	0.004/0	0.006/0	2.85/0	3.06/0	6/A	10/A	absent		NG
53	29500	b/o kavitha	1/365	F	1.94	16010/0	15910/0	79/11/10/0	80/12/8/0	12600/A	12470/A	520	420	0.04/0	0.03/0	1.77/0	1.75/0	8/A	9/A	absent		NG
54	29411	b/o dhanalakshmi	1/365	M	1.96	13130/0	12100/0	65/24/11/0	65/24/10/1	8460/A	7890/A	420	530	0.1/0	0.01/0	1.28/1	1.57/0	12/A	11/A	present	32 hrs	NG
55	29617	b/o kousalya	1/365	M	2.27	10820/0	11710/0	62/23/13/0	62/24/12/0	6690/A	7240/A	60	50	0.01/0	0.01/0	1.93/0	2.11/0	12/A	10/A	absent		NG

56	29992	b/o praveena	1/365	M	2.21	9420/0	9480/0	31/51/18/0	32/51/17/0	2880/A	3000/A	110	120	0.03/0	0.04/0	3.62/0	3.72/0	11/A	9/A	absent		NG
57	30196	b/o vinodhini	1/365	F	2.06	2030/1	2410/1	63/26/11/0	59/20/21/0	1260/P	1400/P	100	200	0.1/0	0.1/0	1.02/1	0.94/1	15/P	17/P	present	40 hrs	staph aureus
58	30249	b/o sivagami	1/365	F	1.89	6850/0	7460/0	44/49/7/0	43/49/8/0	3310/A	3200/A	110	70	0.03/0	0.02/0	1.25/1	2.11/0	10/A	12/A	present	33 hrs	NG
59	30461	b/o vanaja	1/365	M	1.82	13370/0	12510/0	83/12/5/0	83/11/6/0	11080/A	10360/A	140	140	0.01/0	0.01/0	1.79/0	1.71/0	10/A	11/A	absent		NG
60	30411	b/o anitha	1/365	F	2.98	15640/0	14330/0	69/19/12/0	69/20/11/0	10750/A	9800/A	400	270	0.03/0	0.03/0	1.03/1	1.26/1	10/A	11/A	absent		NG
61	30159	b/o indhu	1/365	M	1.78	6040/0	5770/0	48/41/11/0	48/42/10/0	2840/A	2760/A	110	110	0.03/0	0.03/0	1.7/0	1.59/0	11/A	10/A	absent		NG
62	28976	b/o durgalakshmi	1/365	F	2.66	7530/0	7770/0	56/30/14/0	57/30/13/0	4170/A	4380/A	190	120	0.04/0	0.03/0	2.41/0	2.83/0	10/A	12/A	absent		NG
63	30663	b/o gajalakshmi	1/365	F	1.68	7140/0	4530/1	51/40.9/0	50/42/8/0	3610/A	2260/A	260	180	0.1/0	0.1/0	1.66/0	1.1/1	17/P	16/P	present	36 hrs	NG
64	30956	b/o amudha	1/365	M	2.63	14330/0	14670/0	69/19/12/0	68/22/10/0	9800/A	8740/A	570	480	0.1/0	0.1/0	1.78/0	1.96/0	16/P	14/A	present	41 hrs	pseudomonas
65	31001	b/o thilakavathi	1/365	M	2.77	12640/0	12420/0	68/23.9/0	68/24/8/0	8520/A	8390/A	170	170	0.02/0	0.02/0	2.43/0	2.2/0	11/A	12/A	absent		NG
66	30427	b/0 sasi	1/365	F	1.95	17240/0	17520/0	70/28/2/0	68/26/6/0	12068/A	11910/A	520	600	0.1/0	0.1/0	1.86/0	1.9/0	12/A	13/A	present	40 hrs	NG
67	30483	b/o vimala B	1/365	F	2.73	17600/0	17760/0	68/21/11/0	65/30/5/0	11960/A	11540/A	560	540	0.04/0	0.04/0	2.1/0	2.26/0	17/P	18/P	present	26 hrs	NG
68	30488	b/o anithadevi	1/365	M	1.85	4740/1	4680/1	70/28/2/0	68/30/2/0	3310/A	3180/A	540	460	0.2/1	0.2/1	2.6/0	2.18/0	10/A	11/A	present	17 hrs	pseudomonas
69	30601	b/o jeevalakshmi	1/365	F	1.65	10700/0	11200/0	58/30/12/0	60/30/10/0	6200/A	6720/A	420	480	0.1/0	0.1/0	2.1/0	2.18/0	10/A	9/A	absent		NG
70	30641	b/o eswari	1/365	M	2.28	17200/0	17800/0	68/30/2/0	72/20/8/0	11690/A	12810/A	520	560	0.1/0	0.1/0	2.1/0	2.18/0	12/A	13/A	present	32 hrs	klebsiella
71	30670	b/o sridevi	1/365	F	2.22	7800/0	8100/0	60/32/8/0	68/30/2/0	4680/A	5500/A	320	310	0.1/0	0.1/0	2.86/0	2.7/0	6/A	5/A	absent		NG
72	30675	b/o tamilselvi	1/365	F	1.68	4800/1	4450/1	72/20/8/0	68/28/6/0	3450/A	3026/A	540	520	0.2/1	0.2/1	2.1/0	2.4/0	17/P	16/P	present	14 hrs	staph aureus
73	30678	b/o devi	1/365	M	1.84	4910/1	4680/1	50/40/10/0	51/39/10/0	2420/A	2370/A	300	310	0.1/0	0.1/0	2.1/0	2.03/0	18/P	17/P	present	19 hrs	enterococci
74	30838	b/o devisri	1/365	F	2.6	6270/0	5640/0	38/52/10/0	30/50/13/7	1400/P	1250/P	100	60	0.1/0	0.04/0	2.43/0	2.32/0	10/A	7/A	absent		NG
75	31241	b/o venilla	1/365	M	2.4	11840/0	11940/0	56/26/12/6	60/25/15/0	6570/A	7164/A	180	190	0.01/0	0.01/0	2.4/0	2.27/0	10/A	6/A	absent		NG
76	31372	b/o dhanalaxmi	1/365	F	3.37	7240/0	7610/0	68/30/2/0	70/30/0/0	4830/A	5320/A	420	460	0.1/0	0.1/0	2.1/0	2.8/0	7/A	6/A	absent		NG
77	31406	b/o ramya	1/365	M	2.2	8450/0	8670/0	65/25/10/0	67/30/3/0	5490/A	5800/A	410	420	0.1/0	0.1/0	2.2/0	2.6/0	7/A	8/A	absent		NG
78	31525	b/o dhivya	1/365	M	2.08	6640/0	6420/0	38/45/13/0	37/45/14/0	2520/A	2350/A	90	110	0.01/0	0.01/0	1.82/0	1.96/0	6/A	7/A	absent		NG
79	31534	b/o kaleshwari	1/365	M	2.47	13370/0	12420/0	82/12/14/0	83/10/7/0	11080/A	10370/A	140	140	0.01/0	0.01/0	1.79/0	1.72/0	11/A	13/A	absent		NG
80	32870	b/o rohina	1/365	M	2.98	12120/O	13120/0	65/24/11/0	65/25/10/0	7930/A	8520/A	530	420	0.1/0	0.01/0	1.57/0	1.28/1	10/A	8/A	absent		NG
81	32980	b/o vijayashanthi	1/365	M	2.21	11720/0	10840/0	62/24/14/0	62/23/15/0	7240/A	6690/A	50	60	0.01/0	0.01/0	2.11/0	1.93/0	12/A	10/A	absent		NG
82	33201	b/o sugunam	1/365	M	1.65	17600/0	17420/0	70/25/5/0	68/30/2/0	12320/A	11840/A	520	600	0.04/0	0.05/0	1.1/1	1.28/1	17/P	16/P	absent		NG
83	33413	b/o subbhulakshmi	1/365	F	2.24	8750/0	8540/0	55/40/5/0	58/30/12/0	1810/A	4950/A	240	250	0.04/0	0.05/0	2.5/0	2.6/0	14/A	15/P	absent		NG
84	33449	b/o srilekha	1/365	M	2.81	13050/0	12850/0	55/20/18/7	58/30/12/0	7170/A	7450/A	300	270	0.04/0	0.03/0	2.86/0	2.7/0	`14/A	13/A	absent		NG

85	33704	b/o farhana	1/365	M	2.4	6450/0	6730/0	62/32/6/0	65/23/12/0	3990/A	4370/A	450	360	0.1/0	0.1/0	2.4/0	2.1/0	7/A	6/A	absent		NG
86	33714	b/o kanagalakshmi	1/365	M	1.87	8560/0	8780/0	45/43/12/0	39/50/11/0	3820/A	3380/A	290	210	0.1/0	0.1/0	2.25/0	2.1/0	10/A	8/A	absent		NG
87	33724	b/o dhanalakshmi	1/365	M	2.68	6040/0	5760/0	48/40/12/0	48/42/10/0	2850/A	2650/A	110	110	0.03/0	0.04/0	2.7/0	1.59/0	10/A	9/A	absent		NG
88	33734	b/o chitra	1/365	M	2.68	7540/0	7760/0	56/32/12/0	57/30/3/0	4160/A	4280/A	190	120	0.04/0	0.03/0	2.41/0	2.83/0	14/A	13/A	absent		NG
89	33942	b/o devi	1/365	F	2.29	9450/0	9650/0	45/45/10/0	48/48/4/0	4250/A	4630/A	260	250	0.1/0	0.1/0	2.1/0	2.48/0	14/A	10/A	absent		NG
90	34214	b/o girija	1/365	M	2.28	4240/1	4520/1	55/40/5/0	58/35/7/0	2330/A	2620/A	350	380	0.2/1	0.1/0	2.1/0	2.7/0	16/P	17/P	absent		NG
91	34234	b/o anadhi twin A	1/365	F	2.33	17280/0	17920/0	68/20/12/0	71/22/7/0	11750/A	12700/A	520	600	0.04/0	0.04/0	1.48/1	1.23/1	14/A	13/A	absent		NG
92	34338	b/o sahira	1/365	F	2.81	8210/0	8420/0	57/30/13/0	56/32/12/0	4670/A	4710/A	220	210	0.04/0	0.04/0	2.83/0	2.72/0	7/A	6/A	absent		NG
93	34391	b/o kalaimathi	1/365	F	2.35	7760/0	7870/0	57/30/10/3	56/28/10/6	4370/A	4160/A	120	190	0.03/0	0.04/0	2.7/0	2.4/0	6/A	5/A	absent		NG
94	34536	b/o sangeetha	1/365	F	2.84	10510/0	9660/0	60/25/15/0	57/26/13/4	6270/A	5690/A	140	110	0.02/0	0.02/0	2.32/0	2.48/0	10/A	8/A	absent		NG
95	34687	b/o sasikala	1/365	M	1.74	11420/0	10300/0	57/27/15/0	59/29/12/0	6590/A	5900/A	550	560	0.1/0	0.1/0	1.19/1	1.38/1	10/A	7/A	absent		NG
96	34782	b/o anjali	1/365	M	3.04	11120/0	13100/0	68/20/12/0	77/15/8/0	7520/A	10110/A	90	150	0.01/0	0.01/0	2.83/0	2.76/0	12/A	13/A	absent		NG
97	34808	b/o dhahisha	1/365	M	2.54	8280/0	5320/0	56/27/34/0	59/28/30/0	4700/A	3130/A	280	50	0.1/0	0.02/0	1.56/0	1.7/0	11/A	14/A	absent		NG
98	34874	b/o rajeshwari	1/365	M	2.02	5320/0	6600/0	59/28/13/0	41/49/10/0	3130/A	2690/A	90	90	0.03/0	0.03/0	1.82/0	1.68/0	12/A	10/A	absent		NG
99	34928	b/o sandhiya	1/365	F	2.18	10600/0	11200/0	35/52/13/0	40/45/15/0	3710/A	4480/A	70	70	0.02/0	0.02/0	2.66/0	2.72/0	12/A	14/A	absent		NG
100	37989	b/obhavani	1/365	F	2.09	8430/0	9244/0	56/29/15/0	58/29/14/0	5440/A	5320/A	270	300	0.04/0	0.05/0	2.82/0	3.08/0	12/A	10/A	absent		NG
101	37993	b/o nithya	1/365	F	1.52	17420/0	18200/0	45/50/5/0	55/40/5/0	7930/A	10010/A	550	570	0.1/0	0.1/0	2.46/0	2.76/0	17/P	18/P	absent		NG
102	35183	b/o nehakumari	1/365	M	2.07	5320/0	6550/0	40/44/12/4	53/32/15/0	2120/A	3470/A	270	280	0.1/0	0.1/0	2.82/0	2.78/0	10/A	9/A	absent		NG
103	35208	b/o subha	1/365	M	2.96	6670/0	6860/0	62/28/10/0	63/27/10/0	4130/A	4320/A	350	380	0.1/0	0.1/0	3.1/0	3.28/0	10/A	12/A	absent		NG
104	35282	b/o gauthami	1/365	F	1.85	10140/0	9210/0	52/42/6/0	54/40/6/0	5920/A	6210/A	100	150	0.02/0	0.02/0	1.38/1	1.16/1	17/P	15/P	absent		NG
105	35304	b/o dhivya	1/365	M	1.9	15620/0	14910/0	69/21/10/0	71/20/9/0	10810/A	10530/A	390	300	0.03/0	0.02/0	2.111/0	1.87/0	7/A	8/A	absent		NG
106	35318	b/o meenakshi	1/365	M	2.15	6270/0	5680/0	46/40/14/0	54/30/14/2	2610/A	3110/A	80	60	0.03/0	0.02/0	1.02/1	1.44/1	10/A	14/A	absent		NG
107	54/43/3	b/o janaki	1/365	M	1.86	3210/1	3510/1	72/20/8/0	70/24/6/0	2310/A	2450/A	350	380	0.2/1	0.2/1	2.6/0	2.92/0	17/P	16/P	present	26 hrs	staph aureus
108	35439	b/o maria leela	1/365	M	1.64	7240/0	8210/0	60/32/8/0	58/35/7/0	4340/A	4760/A	320	350	0.1/0	0.1/0	3.08/0	2.7/0	10/A	12/A	absent		NG
109	35598	b/o pushpa A	1/365	M	1.99	5460/0	6210/0	45/50/5/0	48/50/2/0	2450/A	2980/A	320	300	0.1/0	0.1/0	2.18/0	2.36/0	11/A	9/A	absent		NG
110	35599	b/o pushpa B	1/365	M	1.88	6160/0	6520/0	53/30/17/0	54/43/3/0	3260/A	3520/A	220	300	0.1/0	0.1/0	3.72/0	2.9/0	7/A	6/A	absent		NG
111	35737	b/o chitradevi	1/365	F	2.93	12720/0	12240/0	35/55/10/0	38/50/12/0	4450/A	4650/A	420	400	0.1/0	0.1/0	2.3/0	2.7/0	10/A	9/A	absent		NG
112	35683	b/o monisha	1/365	M	1.99	4120/1	4290/1	51/23/16/10	49/26/15/10	2100/A	2170/A	500	520	0.2/1	0.2/1	1.98/0	2.19/0	12/A	11/A	present	33 hrs	klebsiella
113	35762	b/o meena	1/365	F	2.54	8420/0	8580/0	62/28/10/0	58/36/6/0	5220/A	4970/A	520	540	0.1/0	0.1/0	2.4/0	2.72/0	10/A	11/A	absent		NG

114	20780	b/o nandhini	1/365	F	2.05	13520/0	13720/0	66/24/10/0	64/30/6/0	8920/A	8780/A	520	600	0.1/0	0.1/0	2.12/0	2.3/0	12/A	10/A	absent		NG
115	35739	b/o keerthana	1/365	M	2.94	6540/0	6820/0	56/38/6/0	57/33/10/0	3660/A	3880/A	420	480	0.1/0	0.1/0	2.13/0	2.2/0	12/A	13/A	absent		NG
116	35866	b/o krishnaveni	1/365	M	3.68	8420/0	8720/0	72/20/8/0	68/25/7/0	6060/A	5920/A	520	500	0.1/0	0.1/0	2.62/0	2.81/0	10/A	8/A	absent		NG
117	36052	b/o eswari	1/365	M	2.94	9520/0	9470/0	60/36/4/0	55/40/5/0	5710/A	5210/A	520	480	0.1/0	0.1/0	3.08/0	2.9/0	14/A	13/A	absent		NG
118	36065	b/o saranyadevi	1/365	M	2.05	7240/0	7820/0	40/45/15/0	45/48/17/0	2890/A	3510/A	400	380	0.1/0	0.1/0	1.9/0	1.87/0	10/A	12/A	absent		NG
119	36578	b/o manimehalai	1/365	M	2.21	9270/0	9650/0	65/26/9/0	63/20/17/0	6020/A	6080/A	560	600	0.1/0	0.1/0	2.1/0	2.26/0	15/P	14/A	absent		NG
120	36650	b/o chitrasri	1/365	M	2.41	16250/0	16720/0	56/35/9/0	58/34/8/0	9100/A	9690/A	600	620	0.1/0	0.1/0	1.43/1	1.52/0	17/P	16/P	absent		NG
121	36698	b/o latha	1/365	M	3.06	8450/0	8920/0	72/26/2/0	68/27/17/0	6080/A	6065/A	400	380	0.1/0	0.1/0	1.96/0	1.87/0	11/A	10/A	absent		CONS
122	36835	b/o vinitha	1/365	F	2.75	11470/0	10800/0	65/23/12/0	67/24/9/0	7450/A	7230/A	420	380	0.1/0	0.1/0	2.16/0	2.26/0	10/A	9/A	absent		NG
123	36937	b/o shanthi	1/365	F	1.77	6460/0	6780/0	62/30/8/0	65/30/5/0	4005/A	4410/A	520	500	0.1/0	0.1/0	2.2/0	2.18/0	17/P	16/P	absent		NG
124	37031	b/o parimala	1/365	F	2.34	5270/0	5570/0	56/40/4/0	52/42/6/0	2950/A	2890/A	400	300	0.1/0	0.1/0	2.68/0	2.92/0	10/A	9/A	absent		NG
125	37164	b/o dhivya	1/365	F	1.92	12740/0	12450/0	64/24/12/0	61/26/13/0	8150/A	7590/A	420	500	0.1/0	0.1/0	3.08/0	3.12/0	10/A	13/A	absent		NG
126	37245	b/o ishwarya	1/365	M	2.97	9520/0	9780/0	40/45/15/0	45/42/13/0	3810/A	4400/A	400	420	0.1/0	0.1/0	1.86/0	1.8/0	7/A	6/A	absent		NG
127	37491	b/o saranya	1/365	M	2.29	6720/0	6600/0	58/34/8/0	60/32/8/0	3890/A	3960/A	200	220	0.1/0	0.1/0	2.84/0	2.72/0	15/P	16/P	absent		NG
128	37510	b/o kavitha	1/365	M	1.67	13720/0	13460/0	56/38/6/0	59/34/6/0	7680/A	7940/A	420	440	0.1/0	0.1/0	2.28/0	2.52/0	7/A	8/A	absent		NG
129	37616	b/o nandhini	1/365	M	1.83	9460/0	9890/0	56/40/4/0	59/37/4/0	5290/A	5830/A	400	500	0.1/0	0.1/0	2.36/0	2.48/0	8/A	7/A	absent		Ng
130	19291	b/o yasmin twin B	1/365	F	1.41	4240/1	4380/1	56/34/10/0	58/34/8/0	2370/A	2540/A	350	340	0.1/0	0.1/0	1.9/0	1.63/0	14/A	16/P	present	20hrs	staph aureus
131	19879	b/o jayamala	1/365	F	1.48	11140/0	13000/0	76/22/2/0	77/15/8/0	7580/A	10100/A	90	150	0.01/0	0.01/0	`0.83/1	`0.76/1	16/P	18/P	present	16 hrs	NG
132	20118	b/o sonali A	1/365	F	1.32	17500/0	15470/0	68/18/13/0	68/19/12/0	11780/A	10370/A	450	350	`0.03/0	`0.03/0	1.82/0	1.6/0	16/P	17/P	present	20 hrs	staph aureus
133	28562	b/o viji priya A	1/365	M	1.37	7850/0	8690/0	66/18/14/0	65/20/15/0	5190/A	5170/A	220	300	`0.1/0	`0.1/0	1.24/1	1.44/1	15/P	16/P	absent		NG
134	30997	b/o muthulaxmi	1/365	M	1.04	6650/0	6420/0	38/45/7/10	35/45/10/8	2520/A	12400/A	90	100	`0.03/0	`0.04/0	1.82/0	1.95/0	17/P	18/P	present	26 hrs	staph aureus
135	33045	b/o monisha A	1/365	F	1.32	2400/1	2460/1	32/55/13/0	35/56/9/0	760/A	6200/A	230	210	`0.3/1	`0.2/1	1.59/0	1.23/1	16/P	17/P	present	36 hrs	NG
136	33046	b/o monisha B	1/365	F	1.24	3450/1	3670/1	27/50/13/10	25/55/20/0	900/A	10370/A	240	230	`0.3/1	`0.3/1	2.2/0	2.7/0	14/A	15/P	present	14 hrs	NG
137	34235	b/o anandhi B	1/365	F	1.49	16240/0	16720/0	58/35/7/0	61/32/7/0	9419/A	8670/A	560	580	`0.1/0	0.2/1	1.58/0	1.72/0	17/P	16/P	present	17 hrs	NG
138	3463	b/o ruba	1/365	F	1.1	3840/0	3730/1	23/71/6	40/53/7/0	850/A	720/A	150	160	`0.2/1	`0.1/0	1.98/0	2.12/0	17/P	16/P	present	22 hrs	NG
139	35477	b/o kanaga	1/365	M	1.2	17650/0	17920/0	55/45.0/0	55/40/5/0	9700/A	9250/A	520	600	`0.1/0	`0.1/0	1.28/1	1.2/1	17/P	16/P	present	26 hrs	NG
140	19290	B/O yasmin A	1/365	F	1.41	3720/1	3600/1	68/25/7/0	66/24/10/0	2520/A	2250/A	340	300	`0.1/0	`0.1/0	2.96/0	2.68/0	17/P	18/P	present	16 hrs	Klebsiella
141	29017	b/o hemalatha	1/365	F	1.18	3900/1	3840/1	56/30/14/0	50/30/20/0	1930/A	1870/A	560	540	0.2/1	0.2/1	1.42/1	1.5/1	15/P	15/P	present	48 hrs	staph aureus
142	36883	b/o hemalatha	1/365	M	1.19	4650/1	4470/1	61/36/3/0	59/34/7/0	2830/A	2320/A	560	600	0.2/1	0.2/1	2.7/0	2.6/0	15/P	16/P	present	18hrs	klebsiella/1

0 -
ABSENT

1-
PRESENT

A-absent

P-present